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# ***JPRS Report***

# **Science & Technology**

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***Europe***

# Science & Technology Europe

JPRS-EST-91-017

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22 August 1991

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## ADVANCED MATERIALS

### Italy: Advanced Materials Research Center Established

91MI0433 Rome AIR PRESS in Italian 10 Jul 91  
pp 1499-1500

[Text] This autumn may mark the inauguration of the operational complex of the National Research Center for the Research and Development of Materials (CNRSM) in Brindisi, an example of how in Italy also there is a growing awareness both in the public and private sectors of the problem of the transfer of industrial research results from the laboratory to the production plants.

CNRSM is a consortium that has already been in operation for a few years (the current headquarters is at Mesagne, Brescia) doing contract research. Until now it has been involved with the training of researchers in specific sectors of interest, ranging from special materials (from those defined as advanced strategic materials primarily for aerospace uses (composites, new metallic alloys, ceramic materials)) to biomaterials primarily for medical use. The consortium members are the CNR [National Research Council] and ENEA [National Committee for the Development of Nuclear and Alternative Energy] who are the major shareholders with about 15 percent each, ENEL [National Electric Energy Company] (through the CISE [Information Center for Study and Experimentation] of Milan, IRI [Institute for Industrial Reconstruction] (through the SPI financing company in Rome), Enichem, the universities (currently those of Lecce and Tor Vergata in Rome), the provincial administration of Brindisi, and various companies and organizations. In addition to those mentioned are COIMET SpA and IES Srl of Lecce, Edil Bianchi SpA and Salver Srl of Brindisi, and Finpuglia SpA of Bari.

CNRSM has obtained financing (about 100 billion lire) under the program encouraging initiatives in the south of Italy, with which it has been able to make investments for the completion of the buildings and the laboratories, and equip them with scientific instrumentation for the research planned. The advanced equipment includes MOCVD [Metal-Organic Chemical Vapor Deposition] reactors for plasma, physical deposition chambers, special ovens and presses, ion implantation equipment, ESCA [Electron Spectroscopy for Chemical Analysis], AUGER, electron accelerator, SIMS, high resolution electron microscopes with analytical capabilities, equipment for diffractometry and chemical techniques, machines for mechanical malfunction tests and thermoanalysis, optical spectrometry and NMR [nuclear magnetic resonance] spectrometry, parametric analysis system, temperature-controlled chambers, equipment for tribologic characterization, and machines for the production and testing of biomaterials.

Among the private shareholders of CNRSM is Internova (of the Aerocosmos company of the Zanotti group), until now active in the field of mechanical and thermal systems. At the Brindisi Research Center it will carry out

research on metallic and ceramic matrix materials with the aim, AIR PRESS has learned, of developing elements for future spaceplanes, specifically, materials used to cover the surfaces most exposed to excessive friction heating during the re-entry phase into the atmosphere.

The elements are to be produced on a small scale, just enough to carry out experiments, thus at the level appropriate to a small enterprise. The next step might consist of an undertaking in collaboration with the large industries active in the relevant programs and, in order to avoid duplication from the outset, Internova has already contacted CRC, the Consortium for Research on Composites formed three years ago by Alenia, Agusta, and Montedison for the development and production of new composite materials for the aerospace and electronic industries.

CRC is one of the organizations that have planned to create their own research installations in the Brindisi complex where the CNRSM is located. It is a vast area that is the property of the provincial government which has transferred it to a consortium called "Cittadella della Ricerca [Research City]," which has christened the complex PASTIS: Scientific-Technological Park of the Ionian-Salentine Area. Even the Fiat group is present, through the Fidia company (which is involved in biomaterials on behalf of Sorin.) The other operational structures of PASTIS include Biomateriali SpA, Trussardi Ricerche Srl, GEI Inform Srl, SEIPI SpA, Ecoplast Srl, COSMES, COCED SpA, Intec Srl, Formit, and the University of Lecce. Among the initiatives: a national course of preuniversity orientation; the European "Masters" in Science and Technology of Materials; the "Technological Information Window," a national data bank for materials; an international center for microstructural and microanalytical characterization; and a strategic project on polymeric matrix composite materials.

## AEROSPACE

### German, French Contributions to Ariane 5 Described

91MI0392 Duesseldorf HANDELSBLATT in German  
14-15 Jun 91 p 27

[Article by Wolfgang Engelhardt: "German Firms Working on All Major Rocket Systems"]

[Text] Space projects in both the U.S. and Europe are currently suffering under the finance ministers' budget cutbacks. This is particularly true of the international space station Freedom, to which the Europeans are contributing Columbus, and of the European space shuttle Hermes, which is to dock with the Freedom. But money is flowing more freely for the European super-rocket Ariane 5, because it can be used to carry large payloads independently of Freedom, Columbus, and Hermes. Its first launch is scheduled for 1995.

In terms of power, the Ariane 5 is the logical development from its predecessor, as it is capable of taking a 7-tonne payload into what is known as geostationary orbit, 36,000 km above the equator, and 21 tonnes into a lower orbit. The main stage of the Ariane 5 is accelerated by the Vulcain engine, which burns the high-energy fuels hydrogen and oxygen. Two solid-fuel boosters, each 30 m tall and 3 m in diameter, both of which generate an additional thrust of 650 tonnes for 123 seconds, are also used in the launch phase, when the Ariane 5, including payload, measures about 50 m tall, weighs 750 tonnes, and develops a thrust of 1,400 tonnes.

As with an aircraft, the most critical systems the design of a rocket are the propulsion units. Building on their wide-ranging experience in building engines for military and civil rockets (first and foremost Ariane), the French company European Propulsion Corporation (SEP) has also assumed a key role among the participating European states in developing the engines for Ariane 5.

At its Bordeaux and Paris sites, preliminary work is under way for the manufacture of the solid-fuel boosters, in particular the engine sections. Important work on developing the Vulcain rocket engines for Ariane 5's central stage is concentrated at SEP's Vernon site in Normandy, where about half of all the tests on the engine and the individual components, e.g., combustion chamber, turbopump, etc., are also being carried out.

The member states of the European Space Agency ESA have decided that for the construction of the Ariane 5 rocket, too, they will whenever possible commission the best qualified firms to design the various components, even if the cost-sharing formula does not always make this easy. Thus, the boosters for the Ariane 5 rocket are being developed and built by the French group Snecma/SEP, the Italian group SNIA/BPD, and the German firm MAN Technology. The solid-fuel engines consist of seven segments with steel casings (made by MAN) filled with powdered fuel.

The boosters will not be assembled into operational units until they reach the launch site in French Guyana. Particular attention is being paid to the joints between the segments, which, with the American shuttle system's similarly constructed booster, were responsible for the Challenger disaster in 1986. "We want to test the first fully assembled booster for Ariane 5 in Kourou in mid 1992; we plan 10 of these combustion tests before the entire rocket's first launch in 1995," says program manager Jean-Paul Bernard of SEP in Bordeaux.

SEP is France's leading research institute for the development, testing, and construction of rocket engines. It is currently working primarily on producing the engines for the Ariane 4 rocket and developing the engines for the Ariane 5. Of SEP's 4,100-strong workforce, 2,200 employees work in Vernon, 700 of them graduate engineers. It also has about 400 guests from other European

countries involved in the Ariane program. SEP employs around 500 experts on quality control in Vernon and its other locations.

For all France's ambition in space matters, even the chief managers and engineers at SEP stress that such expensive projects as the Ariane 5 rocket are only possible in the context of European technological and financial cooperation. About 3,500 experts in more than 100 companies in the 12 member states of ESA are working on the development and construction of the new Ariane rocket.

It is true that France is bearing 44.7 percent of the costs, which are estimated at more than 8 billion German marks [DM], but Germany is contributing a respectable 22 percent, Italy 15 percent, Belgium 6 percent, and Spain 3 percent. At present around DM4 million a day are being spent on developing Ariane 5.

German firms are involved in all the major systems for the new European launcher. For the central main stage, Dornier is building the tank domes, MAN the skirt, and MBB important parts of the liquid fuel engine. Moreover, MBB-ERNO is the prime contractor for the L7 upper stage that will place the satellites in geostationary transfer orbit. Zeppelin Works in Friedrichshafen is supplying its fuel tanks, Dornier is building the SPELTRA [external carrier structure for triple Ariane launches] multiple launch system, and MAN the steel claddings for the solid fuel boosters, and—more of an earth-bound investment—all the metal structures for the ELA-3 launch sites in Kourou, where Ariane 5 will be launched.

In relation to the payload weight, the new European rocket will be about 40 percent cheaper than the Ariane 4, which is still in use today, while its payload capacity is 50 percent higher. The costs of an Ariane 5 launch are put at around \$100 million; for this sum three satellites of the current weight and performance class can be carried, whereas the Ariane 4 can carry only two such payloads into geostationary orbit at a cost of \$120 million. The two solid-fuel boosters with their relatively short and thus highly concentrated thrust are an important factor in the Ariane 5's favorable power range.

### **Italy's Telespazio To Control Italsat Satellite Orbit**

*91MI0337 Rome AIR PRESS in Italian  
17 Apr 91 p 842*

[Text] Telespazio (IRI-STET [Industrial Reconstruction Institute - Turin Telephone Company] has taken over the complete management of the ASI's (Italian Space Agency) Italsat telecommunications satellite from ESOC [European Space Operations Center] in Darmstadt. The first experimental transmissions will begin this summer. After a period of joint management, which began immediately after the satellite's launch on 15 January, the ESA's (European Space Agency) ESOC center and Telespazio completed the transfer of responsibilities for the

control and management of Italsat while in orbit. Telespazio's Fucino space center followed Italsat's transfer into orbit from the very beginning, acquiring telemetry signals; and acting as the primary control station for the orbiting Italsat on behalf of the ESA. After the positive results of this collaboration, the transfer of duties phase began and was terminated in the past few days. Telespazio manages the satellite under a contract with the ASI and for this reason it established the Fucino control center, the telemetering stations and remote control station (in the S band) to guide the satellite and for telecommunications (in the KA band), and two reference stations for the satellite's antennas, located in Cagliari and Courmayeur, near Aosta. Italsat is in a geostationary orbit 36,000 Km from Earth and 13 degrees longitude east of the equator, in correspondence with the meridian of Rome.

## BIOTECHNOLOGY

### German Law on Genetic Engineering Explained

91MI0418 Munich MPG SPIEGEL in German  
3 Jun 91 pp 6-11

[Article by Dr. Hans-Georg Heidrich, who is in charge of safety at the MPI: "Scientists Must Learn Paragraphs"; first paragraph is MPG SPIEGEL introduction]

[Excerpts] Dr. Hans-Georg Heidrich, a member of the Max Planck Institute [MPI] of Biochemistry at Martinsried, where he is responsible for biological safety, illustrates for MPG SPIEGEL the extensive provisions of the Federal Republic of Germany's new law on genetic engineering. He also reports on the MPG's first training event at the Martinsried institute at the end of March, which was attended by 70 participants and covered the application of various provisions of the law on genetic engineering and the accompanying regulations.

The new law on genetic engineering (GenTG) and the five accompanying regulations came into force on 1 July 1990. These regulations are legally binding for the establishment of workplaces concerned with the research, production, and marketing aspects of genetic engineering, for the conduct of all genetic engineering work, for the release of genetically modified organisms, and for the marketing of products containing or consisting of genetically modified organisms. This extensive framework of regulations does not cover work in the overall field of human genetics: Embryos are already protected by law, and genome analysis and gene therapy are to be covered by separate laws.

### The Law on Genetic Engineering

The Federal Republic of Germany's new law on genetic engineering, with its extensive body of laws and regulations that are not easy to interpret, is the first law of its kind anywhere in the world. It is intended "to protect human, animal, and plant life and the rest of the environment as regards its entire constitution and material

assets from potential dangers inherent in genetic engineering processes and products, and to prevent such dangers from arising" (Article 1). The GenTG is also intended "to create the legal framework for research into and the development, use, and promotion of the scientific and technological possibilities of genetic engineering" (Article 1). Since the law's provisions are to apply to genetic engineering workplaces, genetic engineering work, and products containing or consisting of genetically modified organisms, it requires the owner or person in charge of a research or commercial organization working with genetic engineering, the "operator," to go through a relatively extensive, complicated procedure for the registration and approval of laboratories and production premises ("genetic engineering plants") and the work to be carried out there. This work is classified according to various safety levels, for some of which onerous safety measures have to be imposed by the operator and observed by employees. These safety levels are based on the hazard potential of the donor and recipient organisms (bacteria, viruses, parasites, or fungi) used in the work, on the vectors used, i.e., the carriers of genetic information from the donor organism to the recipient organism, and the properties of the organisms genetically modified in the experiment.

In Appendix 1 to the Genetic Engineering Safety Regulation (GenTSV), committees of experts have drawn up a comprehensive list of donor and recipient organisms and divided them into four risk groups to assist the scientist in assessing risk and safety classification in his experiments. They range from Level 1 ("no risk") to Level 4 ("high risk or grounds for suspecting such risk to human health or the environment"). Risk assessment and safety classification are set out in great detail in the second section of GenTSV, especially in Articles 4, 5, and 7, and are compulsory before the start of any new project. They must be carried out by the scientist in the light of the most recent scientific and legal information. They are then examined, and if necessary corrected, as part of the complex registration and approval procedure, by the Central Commission on Biological Safety (ZKBS). Only then are they approved by the competent land authority. The law on genetic engineering places both final approval and monitoring of the implementation of the GenTG, the legal regulations, and the consequent official directives and provisions concerning genetic engineering plants and work in the hands of the *laender* where these plants are operated, rather than the Federal Government. This represents a new departure and makes for closer, more monitorable cooperation between the approving authority, especially the supervising body, and the operator. All genetic engineering experiments must be documented by records, which must be kept according to the detailed provisions of the Genetic Engineering Record Regulation (GenTAufsV) and must be open to inspection by the supervising authority at all times.



### Liability and Fines

The Genetic Engineering Safety Regulation (GenTSV) is a decisive part of the law on genetic engineering. It sets out in detail a number of provisions not detailed in the GenTG, especially safety measures, and also the duties, tasks, responsibilities, and knowledge required of those responsible for genetic engineering work. Article 38 of the GenTG contains a list of infringements, including infringements of the GenTSV (Article 20 of the GenTSV), incurring substantial fines of up to 100,000 German marks [DM]. Article 39 of the GenTG even specifies up to five years' imprisonment for those who by particular actions endanger "life or limb of another person, third-party property of significant value, or parts of the natural heritage having substantial ecological significance"; the penalties for negligence are also severe. It is primarily the operator in whose name a genetic engineering plant is functioning who is liable for these penalties. The operator also bears a high measure of responsibility for damage to health or property arising from genetically modified organisms, the maximum fine being DM160 million. For example, the operator of all the Max Planck Society's genetic engineering plants within the meaning of the GenTG is the corporate legal entity of the Max Planck Society itself. In accordance with Article 28, Paragraph 3k of the MPG's constitution, in the individual institutes, the managing director concerned is the operator's representative and as such is responsible for all duties incumbent upon the operator under the law on genetic engineering. The managing director may delegate certain responsibilities and duties, for example to project managers, though this must be done in writing. Project managers are defined as the scientists in the individual institutes who have registered or applied to register genetic engineering projects in their own names. They bear full responsibility for the direct planning, management, and supervision of their areas of genetic engineering work and projects, and are thus also liable for fines and penalties under the law on genetic engineering.

A very important section of the GenTSV in terms of the practical application is Section 3, which governs the safety measures required for genetic engineering work, specifically workplace health and safety procedures, technical and organizational safety measures for laboratories and production areas, safe working procedures, and requirements for effluent and waste disposal.

Safety measures covering laboratories and production areas are strict and detailed, and also encompass greenhouses and animal houses. In addition to building and technical regulations, they also include regulations concerning the marking of and access to laboratories, with what apparatus they must be equipped, the handling of potentially dangerous organisms, and regulations concerning cleansing and, more particularly, deactivation, disinfection, and disposal.

Article 12 of the GenTSV, which governs safe working procedures, places great emphasis on adequate levels of

training and thorough instruction for employees via lectures, instructions for running the plant and performing individual jobs, and accident procedures. The same applies to ancillary and cleaning staff.

The operator is able to call on the advice of the Biological Safety Officer, who also monitors genetic engineering plants and working procedures and project leaders' performance of their duties relating to safety in genetic engineering work.

Article 12 of the GenTSV and Annex VI thereto, set out in exemplary fashion the medical care, such as preventive medical examinations, for employees working at safety levels 2 to 4. Preliminary examinations must be carried out before recruitment, and follow-up examinations are required annually. Operators must maintain records of examinations, and in the event of a workplace representing a hazard to employees, it must be inspected, on medical recommendation and in the employees' interests, and measures to protect the individual employees must be arranged. In addition, blood tests undertaken during medical examinations must be kept for 10 years, so that they can be used for comparison during the employees' subsequent checkups. Provided it is correctly applied in accordance with the GenTSV and in conjunction with the relevant regulations laid down by the mutual indemnity association, Article 12 guarantees that damage to employees' health arising from working in genetic laboratories will be avoided.

### Initial Difficulties Encountered in Implementing the Law on Genetic Engineering

It will be clear that applying such a complex set of regulations to authorities, research establishments, and commercial enterprises and rendering it legally binding in a very short period will give rise to widespread uncertainty, ambiguities, questions of interpretation, and other problems that are either difficult or impossible to resolve. The following problems have become apparent in the introduction of the new law on genetic engineering:

- Definitions arising solely from nuances of punctuation, something that the scientist does not normally encounter in his specialist terminology;
- Minor scientific or organizational details, overlooked by the legislators but of importance for the lawful performance of genetic engineering work, for example when handing over genetically modified organisms to third parties;
- Officials and scientists use different terminologies, so each group must familiarize itself with the other's;
- Officials and researchers have entirely different areas of specialist knowledge.

It is widely known that the scientist is not always willing to subordinate his right to freedom of research to legal restrictions that, in his view, are no more than regulations. The authorities, on the other hand, can be unwilling to accept what strikes them as the somewhat casual, improper attitude of some scientists toward the

law. We must therefore build up a framework of professional cooperation between the authorities and research and commercial establishments working in genetic engineering.

#### **Expertise of Project Managers and Biological Safety Officers**

This process is facilitated by the law on genetic engineering itself: Articles 15 and 17 of the GenTSV require substantial expertise on the part of project managers and biological safety officers alike, not only in conventional and molecular genetics and in handling microorganisms, but also with regard to their knowledge of safety procedures and health and safety in genetic engineering work. In these latter two areas, they must possess a certificate of attendance at a training course covering the following subjects:

- Hazard potential of organisms with special regard to microbiological aspects;
- Safety procedures for genetic engineering laboratories and production areas;
- Legal requirements on safety procedures in genetic engineering laboratories and production premises; and
- Legal requirements on health and safety at work.

Article 15 of the GenTSV states that the authorities concerned may recognize in-house training courses, provided they are conducted in accordance with Article 15(4). This is absolutely essential during this initial phase of application of the law on genetic engineering. The Mutual Indemnity Association of the Chemical Industry and DECHEMA [German Chemical Apparatus Engineering Society] are in fact running very few courses of this kind this year, which are naturally fully booked. In order to register a new genetic engineering plant within Safety Level 1 and the work to be carried out there, or in order to obtain licences for plants and activities within Safety Levels 2, 3, and 4, project managers and biological safety officers must be able to show, as part of the application or registration procedure, that they have attended such a training course (exemption being granted to project managers who have already worked for at least two years in the same capacity in a laboratory registered under ZKBS guidelines). Thus, for junior scientists, attendance at such a course constitutes an absolute prerequisite for work as a genetic engineering project manager. Owing to the shortage of places, attendance at a course at one of the above organizations has to date been open to only a few, so in-house training programs provide one of the few solutions to this problem.

#### **Draft Curriculum Presented**

It is only recently that a draft curriculum for these training courses has been presented at the land level. It comprises 24 45-minute lectures and lists the minimum requirements for a training course in accordance with Article 15 of the GenTSV. The draft specifies that the training course must involve a balanced number of

speakers from both the authorities and from the research and production side. This team of speakers must also work together, coordinate the content of their lectures, deliver their lectures, lead discussions and answer questions from the audience, clarify any doubts and ambiguities, and respond to suggestions. The very fact of working together on these programs makes for a remarkable degree of mutual understanding and helps to translate the theoretical wording of the text of the law's various paragraphs and the terminology of officialdom into the practical context of scientific and industrial work.

The requirement for new project managers and biological safety officers to have attended such a training course has created a critical situation at the MPI of Biochemistry at Martinsried that would have made it almost impossible to have future genetic engineering laboratories and projects licensed. The author of this article, who had been appointed by the operator of the Martinsried MPI as its biological safety officer, took this situation as a challenge to his personal initiative. In a model of cooperation between the authorities concerned, i.e., the government of Upper Bavaria as the licensing authority and the Ministry of Land Development and Environment Issues of the State of Bavaria as one of the supervising authorities, a number of highly reputed and experienced speakers from both those authorities, the Mutual Indemnity Association of the Chemical Industry, the Biotechnology Research Society, and Boehringer Mannheim, a company medical officer, and two speakers from the MPI of Biochemistry under the direction of the institute's biological safety officer held a three-day training course for project leaders and biological safety officers. [passage omitted]

The institute now has a biological safety officer in every department and several young potential project leaders. The various officers will shortly be brought together to form a Committee on Biological Safety (Article 16 of the GenTSV), which will settle representation issues and be able to call on as broad a range of expertise as possible in matters of genetic engineering. This procedure will also ensure that the registration of and application for genetic engineering plants and activities in the institute will be made competently and in accordance with the correct procedure, avoiding delays due to requests by the authorities for further information.

Since the Federal Republic of Germany's new law on genetic engineering already takes account of the relevant EC guidelines, it is to be hoped that when a future European law on genetic engineering, which is currently being considered by the individual EC member states, comes into force, a few minor shortcomings may be corrected and clarified but that no basic, substantial amendments or restrictions will be introduced. It would be a great obstacle to scientific progress if the extremely strict regulations embodied in the law on genetic engineering, and which have already been put into practice, were to be replaced by even more restrictive ones. The international response to the Federal Republic's law on genetic engineering does however give grounds to expect that the opposite is more like to happen in the EC.

## ENERGY, ENVIRONMENT

### EC Environment Program Summarized

91MI0394 Wuerzburg UMWELTMAGAZIN  
in German Jun 91 p 96

[Text] "Europe 2000—Prospects for Future Regional Planning in the Community." This is the heading under which the European Commission in Brussels is tackling the urban environment. It is obvious that dirt, which knows no frontiers, can no longer be allowed to continue building up or being tipped into watercourses. But Brussels has made one thing clear: All it can do is lay down general guidelines for the Community, like those it has just issued on the treatment of urban sewage. Environmental legislation is not subject to the exercise of centralized power: By the end of this year, a draft bearing the title "Europe 2000" is to be circulated to all 12 member states. It will take the form of guidelines drafted with the participation of regional and local authorities.

The EC Commission has already issued a preliminary report on regional planning for the year 2000. The aim is to achieve an "efficient regional policy with a clear conception of the future shape that the whole Community area is to take." The following priorities are identified:

- The need to develop a network of links between cities to strengthen contacts between them and make full use of existing complementary laws, taking particular account of peripheral regions;
- The importance of developing rural areas, in which traditional, predominantly agricultural, activities are encountering increasing difficulties;
- Assessment of the longer-term socioeconomic effects of the population explosion in non-EC Mediterranean countries and the consequences for European Community policies;
- In direct relation to the previous item, the increasing influx of foreign immigrants, including those from eastern Europe;
- The socioeconomic effects of the growing proportion of old people in the population of EC countries.

The above represents only a small proportion of the topics to be addressed. The effects of population concentrations are already well-known. In addition to urbanization, the development of rural areas, and transport networks, other matters requiring urgent discussion and assessment in terms of their impact on the environment include power supplies, the transition to renewable sources of energy, environmental quality, and the problems of the coastal areas, which are dependent on fishing (and also "overfishing").

Environmental quality concerns not only such familiar matters as the high level of air pollution in the industrial conurbations ( $\text{SO}_2$  and  $\text{NO}_x$ ). Other topics include water

source and supply problems, water pollution, soil erosion, especially in the Mediterranean region, soil pollution in industrial areas (especially in eastern Germany and eastern Europe) and the pressures of competition on land use in coastal areas, where insufficient controls lead to environmental damage.

Certain aspects that are frequently passed over will be specifically addressed in Brussels, such as the endangering of our natural heritage of fauna and flora. The area covered by the European Community is marked by an environment of great diversity, with the south being richer in species than the north. For instance, the Alps alone possess as many species of plants as the whole of Great Britain, while 60 percent of flowering plants and 70 percent of mammals and amphibian species are native to Italy.

The members of the European Environmental Agency have already presented their "White Paper for an EC Ecological Economic Policy." This also stresses the European Community's responsibility for drawing up outline rules on ecological controls, minimum standards for emissions, basic principles for realistic attribution of costs to firms, minimum criteria for approval procedures, environmental compatibility tests and entitlement to consultation, ecological criteria and procedures for environment-oriented regional planning, and product standards imposing minimum safety requirements. The individual states must however retain the right to improve on these European standards, since "town councils and regional governments form the most important level for implementing ecological concepts."

### "Green Charter"

Under the auspices of the International Chamber of Commerce in Rotterdam, 200 of the world's leading industrial firms and other business organizations have just committed themselves to the "Green Charter," which aims to establish a rational link between environmental protection and economic growth. The signatories include numerous multinational companies, including automobile and chemical manufacturers. They intend to subject every new business activity to a prelaunch environmental compatibility test. Except for Turkey and Taiwan, all the signatories are from western Europe and North America. The Japanese are not among them.

### Germany: Juelich Research Center Develops Hydrogen Extraction Process

91MI0397 Bonn WISSENSCHAFT WIRTSCHAFT  
POLITIK in German 12 Jun 91 p 4

[Text] Hydrogen is an environment-friendly energy source that can be used in a variety of ways. However, the future use of hydrogen as a secondary energy source depends decisively on the efficient extraction of hydrogen by water electrolysis using nonfossil primary



energy, for example solar energy. In this latter case, it is particularly important that the efficiency of existing water electrolyzers be increased from about 75 to over 90 percent. The Juelich Research Center has developed an energy-saving, economic electrolysis process for this purpose.

The conventional industrial technique of electrolytic water decomposition into hydrogen and oxygen encounters two problems in particular: insufficient catalytic activity and long-term stability in the electrodes, coupled with the separator's temperature sensitivity, which makes it impossible to improve efficiency by raising the temperature. The Juelich Center's advanced energy-saving technology overcomes these disadvantages. Its water electrolysis process can also be used to produce solar hydrogen. Since 1989, a 10-kw electrolyzer, built at the Juelich Research Center for the German-Arab HYSOLAR [Hydrogen from Solar Energy] project, has been running successfully on photovoltaic solar current in intermittent operation at the DLR [German Aerospace Research Institute] in Stuttgart.

#### **Germany: Juelich Center Studies Environmental Aspects of Research**

91MI0422 Bonn *TECHNOLOGIE NACHRICHTEN-MANAGEMENT INFORMATIONEN* in German  
13 Jun 91 p 11

[Text] The question of environmental compatibility is of prime importance not only in the actual planning and building of technical plants; greater efforts are also being made to give adequate consideration to environmental aspects right from the decision-making stage of future policy, plans, and programs. From this stems the need for the state research funding system to examine how far the potential effects of planned lines of development on man and the environment can be identified and taken into consideration at an early stage when deciding on funding for technological projects.

Since the beginning of 1990, the "System Research and Technological Development" program team at the Juelich Research Center has been working on a project commissioned by the BMFT [Federal Ministry of Research and Technology] to develop a method for "environmental check-ups for research projects." The aim is to develop and field-test a practicable procedure for establishing, initially, the necessity and, subsequently, the content and thoroughness, of an environmental compatibility study on research projects. The attempt will be made to bring the principle of prevention of environmental pollution, which is enforced when new technical plants are built via the environmental compatibility test prescribed by law, to bear on research projects as well.

A catalog of questions will be drawn up for future use in the systematic assessment of new research projects and programs with regard to environmental aspects:

- Which repercussions on man and the environment are significant in the research project?

- What effects are known and which can be assessed? Where are there gaps in knowledge (i.e., the need for research) of repercussions on the environment?
- Which effects require further detailed examination?

Criteria for environmental compatibility include factors such as the persistence of substances used in a research project, their tendency to spread, their accumulation, and the degradation processes involved.

The knowledge of any risks to the environment and the application of this knowledge from the research phase onwards promises economic as well as ecological advantages.

Accordingly, industry is also making an effort to integrate environmental aspects into research and development studies.

In addition to the methods proposed by the System Research and Technological Development program team, the roundtable on "Preventive Examining for Environmental Compatibility in Research" held at the Bonn Science Center on 5 June 1991 therefore also presented and discussed further approaches and their potential application, both in projects that are already close to market and in others that are still a long way off.

The project, which has a 300,000-German mark BMFT grant, is scheduled for completion at the end of 1991.

Further information can be obtained from Mr. W. Huber, Juelich Research Center, System Research and Technological Development Program Team, P.O. Box 19 13, D-O-5170 Juelich. Tel: 02461/613584.

#### **LASERS, SENSORS, OPTICS**

##### **France: All-Weather Optical Fiber Developed**

91AN0511 Paris *FRENCH TECHNOLOGY SURVEY*  
in French Apr-Jun 91 p 18

[Text] The Optical Fiber Research and Technology (FORT) Company has developed an optical fiber designed specially for local networks and distribution purposes.

The GOLD optical fiber is completely shielded against water and hydrocarbons, has exceptional strength and a free structure making it simple and quick to install. The fiber is protected by three layers of plastic material, each with specific properties. The first 250-micron layer gives the fiber great strength; the second (410 micron) protects it against water, heat (-50°C to +125 °C), and chemical attack; and the third layer (900 micron) gives outstanding mechanical protection against tensile force and crushing pressure. This tremendous strength makes the GOLD fiber suitable for the most severe operating conditions. It is also very easy to install: Its free structure means that it is simple to strip and can be connected directly to systems with no need for terminal strips or cable ends. The GOLD fiber will be of primary concern to sectors such as distribution, aerospace, medicine, or computing.

### Siemens Laser Produces Superconducting Thin Films

91MI0402 Coburg OPTOELEKTRONIK MAGAZIN  
in German May 91 p 14

[Text] Superconducting films are being produced in series, using the Siemens excimer laser. In addition to its many applications in material processing, the XP 2020 laser can also vacuum plate high-grade superconducting films onto a substrate in a downstream vapor deposition unit. Equipment of this type with a vapor deposition chamber has been in service since early 1990 in the Hans Kolber & Co (FUBA) research center in Bad Salzdetfurth near Hannover. Since then, well over 100 superconducting films of top international quality have been produced.

To manufacture the HTSC [high-temperature superconductor] films, the laser beam is guided at an angle of 45° onto the polycrystalline ceramic material, such as  $\text{YBa}_2\text{Cu}_3\text{O}_7$ , to be vapor deposited. This process ejects atoms and atomic unions out of the material and transfers them in a plasma cloud, perpendicular to the surface, to the substrate being coated, where the cloud condenses and forms a single crystal layer. The thickness of the layer can be varied by varying the vapor deposition time. At a temperature of 90°K, this layer presents a very narrow transition to superconductivity. At 77°K (temperature of liquid nitrogen) critical current densities of  $5 \times 10^6 \text{ A/cm}^2$  are achieved.

The films are distinguished by their low high-frequency losses. In the UHF range (300 MHz up to GHz—equivalent to 1 m to 10 cm wavelength) and at an operating temperature of 77°K, the surface resistance—which is a measure of these losses—is roughly one thousandth that of copper at the same temperature. Such films, and resonators made from them, are currently being tested at FUBA for use in high-selectivity filters for radio receivers. Here the substrate material for the  $\text{Ba}_2\text{Cu}_3\text{O}_7$  films is single-crystal lanthanum aluminate, measuring 10 mm x 10 mm x 0.5 mm, which is used because it has good lattice matching and very low high-frequency losses. Microstrip line resonators are being made from the films by a wet chemical structuring process and stand out for their high intrinsic Q factor, which is a measure of resonator quality. For example, Q factors of 25,000 were achieved at a frequency of 1.4 GHz and a temperature of 77°K. As was shown in September at the Applied Superconductivity Conference in the U.S., this is a peak value for planar HTSC resonators by international standards. Bulky cavity resonators measuring about half their wavelength have been used to date to achieve such Q factors in the UHF band; superconducting resonators are three or four times smaller. The requisite cooling system only slightly inhibits reduction in size if suitable miniature coolers are used.

The high pulse energy, the homogeneous beam profile, and the very high pulse-to-pulse stability of the Siemens excimer laser, which is manufactured in the Karlsteiner

works, give uniform ablation over a large area. This means that extensive film layers of the highest quality can be manufactured reliably. Vapor deposition with the excimer laser offers significant advantages over other processes, because the gas atmosphere can be freely selected and the stoichiometry maintained. Film manufacturing times are relatively short, and multilayer films can be produced in a single operation. Moreover, the laser can also structure the films. However the excimer can be used in the entire field of thin-film technology, not only the narrow area of superconducting films.

### French Laboratory Studying Ceramic Machining by UV Laser

91WS0370A Paris COMPOSITES ET NOUVEAUX  
MATERIAUX in French 2 Apr 91 pp 4-5

[Article: "Ultraviolet Laser for High-Precision Machining of Ceramic Materials"]

[Text] For the last two to three years, the Laboratory of New Ceramics at the University of Limoges has been experimenting with ultraviolet [UV] lasers in its work on laser-materials interactions. More particularly, the research team has focused on ceramics. The experiments have demonstrated the machining capabilities offered by this type of laser. Efforts to machine ceramic materials with conventional lasers ( $\text{CO}_2$  or YAG [yttrium-aluminum-garnet]) have run into problems caused by the heating of the material, which produces phase changes altering the material's properties. The interesting feature of UV lasers is that they go through materials without heating them, thus without causing cracks or other damage. Also, UV lasers can drill holes with diameters on the order of one-tenth of a micron, with a diameter/depth ratio as great as 10. Finally, it is evident that this technique can be used to mark or etch pieces to be machined.

The laboratory has conducted a market study to evaluate potential industrial applications. It turns out there are two marketing possibilities: large-volume applications that would justify establishment of a manufacturing company, and—which seems more probable—small-volume applications with high value added. In the latter case, it might be possible to set up a service company specializing in "a la carte" machining of parts made of diverse materials, since the technique can be used on both polymers and metals.

One possible application illustrating the capabilities of the UV laser is its use with the future Hermes shuttle, for which extremely costly metallic cloth is currently used to filter fluids in the engines. The UV laser technique could be used to simplify manufacture and improve filtering capacity, thanks to the smaller holes it can drill.

The work on UV laser/ceramic interactions is actually a spinoff from a research project already undertaken at the Limoges laboratory of new ceramics to develop thin superconducting lozenges from the new ceramics (whose inventor was awarded the Nobel Prize in 1987 for his

work). A year ago, the Limoges laboratory succeeded in photo-ablating these ceramic pellets with UV laser technology, producing thin superconducting lozenges without annealing them. Industry is expected to begin experimenting with the manufacturing process soon (Thomson has already made some commitments in this area). The Limoges laboratory will probably complete its work to develop ultrahigh frequency [UHF] components sometime this year.

### Germany: Analysts See Billion-Dollar Market for High-Tech Sensors

91WS0367A Duesse/dorf VDI NACHRICHTEN  
in German 10 May 91 p 1

[Article by Jens D. Billerbeck: "Billion-DM Market for Intelligent High-Tech Sensors"; first paragraph is VDI NACHRICHTEN introduction]

[Text] Duesseldorf, 10 May (VDI-N)—Good international position of German manufacturers. Competition comes from far eastern mass production.

German sensor manufacturers are viewing the future with cautious optimism. As Sensor Association (AMA) president Ulrich Fuehrer explained on the eve of the international trade fair Sensor '91, the growth forecast is no longer so euphoric as in past years; however, through the year 2000, market analysts expect current sales to virtually double in all sensor sectors.

For Western Europe, a study by Intechno Consulting in Basel calculated, for example, market growth from 11.8 billion German marks [DM] to approximately DM26.8 billion in the year 2000. Of this, the most dynamic growth will be in the field of automobile and transportation technology, which will virtually triple in that period, from DM2.1 billion to more than DM6 billion. However, the largest market segment is and will continue to be process technology and industrial plant construction through the year 2000 (DM9.4 billion).

Fuehrer, whose association consists of 185 primarily medium-sized sensor manufacturers in addition to 65 research institutes, sees German firms along with Japanese and American producers in the forefront internationally. However, this position must be defended. The experts of the market research firm of Frost & Sullivan, which concerned itself specifically with the position sensor segment, reached the following conclusion: "To be able to coexist with high-tech sensors from Japanese mass production, European manufacturers must always be one step ahead, both in technology and in production methods." Sensor users feel the same: "The development of a secure future in sensor technology will depend to a large extent on the ability of sensor developers to combine varied technical disciplines," says Dr. Wolfgang Ziebart, head of electronics development for BMW in Munich. Micromechanics and microsystems technologies are two key words which illustrate this technological claim.

And this is precisely the challenge for the small and medium-sized companies who are the major players in this area in Germany. With the Microsystems Technologies Support Program, their technological participation in microtechnologies was supposed to be facilitated.

More than 500 applications for indirect-specific assistance of individual projects were submitted in only 13 months. With an assistance volume of DM150 million, the assistance policy's goal was achieved, according to the Federal Ministry of Research and Technology [BMFT]. Originally designed for four years, this part of the program already ended in March of this year. AMA head Fuehrer criticizes that the framework was set too low and, therefore, companies which were ready to take risks had to forego development projects.

But the Nuremberg trade fair Sensor '91 from 14 through 16 May will reveal just how great the innovative potential is in sensor companies. This innovation is important not just for sensor manufacturers; Fuehrer is convinced: "Regardless of how insignificant the sensor may seem, it determines the competitiveness of the end product in which it is used."

Despite its current good competitive position, the German sensor industry is far from being able to rest on its laurels. Because today's high-tech product can be mass produced tomorrow in any low-wage country. Consequently, in addition to the development of new products, it is essential above all to include quality assurance in the competitive arguments, so that in the intermediate term "Germany does not become the supplier for Japanese industry," as Fuehrer provocatively puts it.

### The Sensor Market in Western Europe in 2000 in Millions of German Marks

The sensor market in Western Europe will more than double by the year 2000. The greatest increase will be in sensors for the automobile industry; for that matter, as many as 80 sensors are already found in car manufacturers' top models.

Mechanical engineering.....	3432
Automobile manufacture and transportation engineering .....	6020
Other.....	7888
Industrial plant construction and process technology.....	9460



### Germany's MBB Develops New Color Sensor

91P60234 Frankfurt/Main FRANKFURTER  
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT  
in German 3 Jul 91 p 8

[Text] In microsystems technology, microoptics is opening up new dimensions with regard to miniaturization, stability, complexity and flexibility. The primary functions of microoptics include the generation of light, the fabrication of sensors and light diodes (LEDs), the propagation of luminous power by means of optical waveguides and the capture of light using photodiodes. Silicon wafers, which can be further coated with dielectric and semiconductor thin films are used as base material.

As an example, in its company publication, NEW TECH NEWS (January 1991), Messerschmitt-Boelkow-Blohm GmbH (MBB) in Ottobrunn writes that, with the aid of plasma vapor deposition technology, dielectric layers suitable as optical waveguides or for the manufacture of photodiodes can be built up on a wafer made of single-crystal silicon. For that, temperatures below 350 degrees Celsius are necessary. The silicon wafers can even be fitted with microelectronic circuits beforehand.

Thus, for example, a photodiode exposed to daylight yields a ratio different from that for the light of a light bulb or that of a fluorescent tube. Even the distinction between flame and daylight is possible, which distinction is of particular interest for fire detection. Based upon this principle, a high-resolution sensor was developed which, in the presence of monochromatic light, can recognize over 100 shades of red.

This color sensor represents the heart of a system for classifying liquids. Such a system could have multifaceted applications. Thus, for example, in medical technology, different blood parameters such as blood sugar, cholesterol and others could be determined. In the chemical industry, color transition reactions could be studied or highly sensitive chemical detections could be carried out.

In metal processing firms, the color recognition system could be put to good use in studying the iron concentrations of waste water samples. The system could also be used in the textile industry, where materials are to be studied on the basis of color. According to MBB, owing to the short response times of the photodiodes and apart from purely statistical measurements, the system also permits dynamic measurements involving continuous processes.

### Germany: Zeiss-Jena Technology Center Activities Reported

91MI0325 Stuttgart LASER & OPTOELEKTRONIK  
in German Apr 91 p 14

[Text] The conditions prevailing under the centralized socialist economy led GDR enterprises to aim for an exceptionally high degree of technical self-sufficiency.

For Jena-based Zeiss, this meant in-house development and production of everything it required to set up high-precision optical equipment production lines, from manufacturing engineering to measurement and test equipment. Although economically inefficient, this approach nevertheless led to a series of interesting technical solutions that well-known experts judge to be of outstanding scientific and technical merit.

Now that Zeiss is once again participating in international work following German monetary unification, it seems only reasonable to sell the processes and equipment developed by the company to interested customers and to use the scientific and technical capability that it has built up for customized developments and production contracts.

Jenoptik Carl Zeiss Jena's Optics and Precision Engineering Technology Center specializes in the following areas:

- the calculation, design, and assessment of optical systems and television chains;
- the manufacture of high-precision optical components and high-performance systems;
- the development of high-precision processing and assembly technologies, including the development, construction, and testing of the optical equipment, special machinery, and systems involved;
- the development and construction of high-precision metrology and manufacturing equipment, with special emphasis on automation engineering;
- the development of high-precision microstructure design processes, including the required cleaning technology, the construction of the requisite equipment, and the production of high-precision spacing elements.

### German Academy Develops NADH Spectroscopy Technique

91WS0384A Frankfurt/Main FRANKFURTER  
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT  
in German 31 May 91 p 8

[Article: "Laser Beams Can Distinguish Between Healthy and Diseased Tissue Immediately"]

[Text] FRANKFURT, 30 May. To date it has been impossible for surgeons to distinguish precisely between healthy and diseased tissue during cancer operations. If there is any doubt, incisions are made deeply into healthy tissue in order to prevent the possible spread of additional cancer. After comprehensive year-long research in the former Military Medicine Academy in Bad Saarow near Fuerstenwald, laser beams of specific wave lengths can now distinguish between healthy and diseased tissue immediately and with a high degree of certainty.

The research has proceeded to the point where, in a relatively short time, it could be applied in the operation room. Besides the precise monitoring of the diseased

tissue or cancer exercised during the actual operation, this diagnostic technique also permits the same kind of surveillance to be exercised during transplants, surgical interventions into mucous membranes, in dermatology, and even in cancer treatments themselves involving high-temperature therapy (hyperthermia). It functions on the basis of precisely determined NADH [nicotinamide-adenine dinucleotide]-concentrations, even in cases of multinuclear symplasms, which have become involved because of inflammatory processes, but are not yet themselves directly affected.

The Laser Medicine Center in Berlin (Laser Medizin Zentrum, D-1000 Berlin 45, Krahmerstrasse 6-10), under the direction of Professor Dr. Gerhard Mueller recently assumed administrative control over the scientists involved, and had their research instruments and facilities transferred to Berlin. This new surgical, instant-analysis technique has numerous applications and promises to be quickly accepted, because at the present time no other comparable fast and safe recognition procedure even exists. Surgeons can decide immediately, during the operation, whether they are dealing with healthy or diseased tissue. The conventional rapid procedure required microscope studies before making such decisions, which, depending on the difficulty, could last up to an hour.

The new process, which has scientifically been designated NADH spectroscopy, employs a laser light at a wavelength of 475 nanometers, which is to say, in the ultraviolet range. At this wavelength the molecules of NADH fluoresce with a very high light intensity that is easy to record. NAD is the abbreviation for nicotinamide adenine dinucleotide and one of the most important energy-transfer systems in living cells. It involves a reduction-oxidation system.

The strong, measurable fluorescence only occur in the reduced form and is therefore designated as NADH. The system regulates the enzymatic reactions in functioning and healthy body cells by dehydration and hydration. The NADH reactions are extremely sensitive. Healthy body cells have a high NADH fraction, which can be determined directly from the light intensity emitted. Cells that exhibit between 700 and 100 micromoles of NADH per gram are considered normal or healthy. All values lower than that indicate damage or inflammation. If less than 15 micromoles of NADH are present, the cell is dead or necrotized.

The new technique was primarily developed in order to determine the effect of the laser beams in the tissue during surgical intervention and to be able to estimate it exactly. Eventually, laser beams made possible delicate operations on organisms and individual cell symplasms, when, for example, they represent cancerous metastasis. Formerly, however, the surgeon performing the operation had to rely on purely statistical values when controlling the laser action. Now he is able to measure and

document the necrotic process of tissue and symplasms—the necrotization—precisely, even as the operation is in progress.

In its first research use the technique, which was developed in Bad Saarow and which to date had been tested in animal experiments, served solely to determine the effect of medical lasers and their operational dosage capability. However, with the quantitative determination of NADH fluorescence in all tissue cells, it has broken through all initial expectations by far.

The technical expenditures for laser-induced fluorescence diagnosis are still relatively high. The procedure requires that, besides the operation and surveillance lasers, another laser in the ultraviolet also be used. In addition, the requisite sensors—mostly in the light waveguide fibers which pick up the light intensity of the NADH fluorescence and guide it further along—must also be employed. Simplifications lie ahead and now must be promoted, since they will bring about substantial cost reductions in the surgical procedures, at least in the mid term.

On the basis of his experience in laser medical applications, Professor Mueller estimates that such systems would cost about 100,000 German marks [DM]. When the appropriate industry takes on this instant diagnosis system, more practical instruments, depending on their specific use, could be developed for from DM30,000 to DM60,000 apiece. Once the basic financing has been assured, partners in the industry could be found to introduce the new diagnostic procedure on the world market.

#### **German University Studies Applications of Oxidic Crystals**

91MI0438 Duesseldorf *HANDELSBLATT* in German:  
11 Jul 91 p 14

[Text] To link laser light as the fastest carrier with oxidic crystals as the best form of data storage and processor is the aim that scientists and their collaborators have set themselves in Osnabrueck University's special research program on "oxidic crystals for electro- and magneto-optical applications." They say that this should make it possible to store light-optical information in a minute space.

The Osnabrueck scientists' research is based on the discovery that light can displace electric charges in crystals. If two laser beams cross in such a crystal, the light pattern so produced can be stored as a charge pattern. Moreover, one beam may control, switch, or amplify the other. They say that this can be used in applications such as the development of an optical computer, which will run on light instead of electricity.

The interdisciplinary team of scientists is seeking to grow new crystal materials by changing their chemical composition and to make targeted improvements to known varieties. Professor Ortwin Schirmer, spokesman

for the team of researchers, says that the crystals so produced will make it possible to achieve a storage density comparable with that of the human brain. It should also be possible to call up large quantities of information in fractions of the time required to date.

#### **Germany: R&D at Bremen Institute of Applied Laser Technology**

91MI0440 Duesseldorf *HANDELSBLATT in German*  
17 Jul 91 p 16

[Article by Christine Backhaus-Lautenschlaeger: "Laser Revolution in Surface Technology"]

[Text] In addition to conventional laser-processing of materials and optical methods of quality control (holographic interferometry), the Bremen Institute of Applied Radiation Technology (BIAS) has set up a novel research project: laser-aided surface microtechnology. Professor Simeon Metev, the BIAS departmental head in charge of the project, is expecting a boom for laser technology in the micro range because lasers are more precise, efficient, specific, controllable, and economic in this range than traditional processes.

The potential practical applications for the various methods of initiating specific chemical and physical processes using laser beams lie primarily in micro- and optoelectronics, conventional and integrated optics, and microsystems engineering. They range from special wear-resistant coatings via highly reflective mirrors for X-rays to micrometer-fine structures on glass.

The main thrust of scientific work at the BIAS is determined by three areas: the laser plasma synthesis of ultrathin multicomponent coatings, the photolytic activation of plastic surfaces, and, finally, laser lithography for surface microstructuring.

The new laser plasma vacuum coating process is based on physical processes that take place when pulsed laser beams act on a solid and remove material in the reaction zone. The laser is used as a source for the vapor deposition of materials in a vacuum chamber. The advantages of the process are that very thin, very dense, sealed and highly complex coatings can be produced.

A coating system may contain any of up to about 100 different layers and form an "artificial crystal lattice with quite exotic properties," Metev explains. This coating technology is particularly suitable for protection against wear in micromechanics, for optical components in X-ray microscopy and microlithography, for high-precision multilayer interference reflectors in UV [ultraviolet] laser engineering, and not least for multicomponent semiconductor and high-temperature superconductor coatings in electronics. When ready for practical application, Metev estimates that the plasma coating plant will cost around 250,000 German marks.

The second line of research concerns the laser activation of surfaces by pretreatment with UV laser light. Quite

specific changes can be made to the properties of polymer materials like polypropylene, and in particular their bonding properties can be improved. In order to produce strong and durable adhesive bonds, the plastics to be joined must be pretreated.

Hitherto this has been done using relatively difficult wet chemical or plasma processes. By contrast, the Bremen scientists expose the surfaces to UV laser light. The surface is activated, producing, for example, active radicals (hydroxyl groups). A laser-induced chemical reaction also occurs between the surface and the adhesive. The result is to increase the adhesive strength, strengthen the bond between metal and plastic, and in some cases to increase bond strength tenfold. This process can later be used to give the pretreated polymers a wear-resistant coating. The next material on Metev's research agenda will be Teflon. "If we manage to coat Teflon, it will be a tremendous advance," he says.

The third research project concerns the laser-aided thermochemical or photochemical microstructuring of surfaces: using the laser to write directly on the material. The advantage here is that the local reaction can be confined within very narrow limits. Metal surfaces can be directly microstructured by this method, which is based on oxidation processes. Silicon strips or copper conductor paths, for example, can be drawn directly on a glass substrate by thermochemical deposition without any additional treatment.

Photochemical, i.e., cold, reactions triggered by UV laser beams can be used to correct faults in integrated circuits: For example, the laser can write an insulating silicon dioxide coating onto them in precisely the required definition.

A further possibility is local photochemical dry etching; thus, for example, silicon is removed from the surface to leave a 10- micrometer fine channel.

Laser lithography methods will primarily be useful for electronics and integrated optics products, Metev says. They also create the premises for the manufacture of flat television screens, which have hitherto been the domain of the Japanese. However, one day LCD [liquid crystal display] screens will be produced in Bremen as well.

#### **Italy: Optical Fiber Transmission Laboratory Established**

91MI0358 Turin *MEDIA DUEMILA in Italian* May 91  
p 69

[Article by Giorgio Rivieccio: "Public Sector Research On Fiber Optics"]

[Text] Italy will become one of the leading manufacturers of new devices for optical fiber telecommunications, and, what is most important, this will be done through government research. A new epitaxial deposition laboratory, established through the joint efforts of the CNR [National Research Council] and the Higher



Institute of Postal and Telecommunications Services, has been inaugurated at the CNR's Montelibretti (Rome) research area. The new laboratory has been set up in the CNR's institute for electronic theory and structures, directed by Professor Sesto Viticoli, with an investment of 8 billion lire (the figure is expected to double over the next five years) and has 15 researchers.

As Viticoli explained, this laboratory will develop devices, such as semiconductor lasers and detectors to be used as repeaters for optical fiber circuits, that will provide improved performance over present technologies. "Our goal," he added, "is to develop new devices that will increase the transmission capacity between one repeater and another and thereby reduce the number of repeaters along the line."

For this reason, the laboratory will use a highly advanced technology known as "epitaxial deposition" featuring equipment that is currently available in only one other location in Italy, CSELT [Turin Telecommunications Study Center] of Turin.

The new devices, to be developed in the Montelibretti laboratory will use innovative materials, such as gallium arsenide and indium phosphide. "These materials," Viticoli explained, "will enable us to develop devices capable of permitting optical fiber transmissions with increased wavelengths. The distance between the repeaters placed along the lines therefore increases, with significant advantages in terms of cost-effectiveness and overall reliability."

This, however, is only the prime objective of the research work carried out in the newly-established laboratory. "The development of high-technology devices," Viticoli stated, "may lead to a series of spin-offs in areas other than long-distance optical fiber transmission. One example is the 'intelligent house', with local optical fiber networks operating at the level of a single building or a whole neighborhood, or optical computer research."

The Montelibretti laboratory's innovative potential, however, is not confined to the type and quality of the technologies used. It occupies a particularly significant position within Italy's research structure. "We are going to build up know-how in the public sector," Viticoli emphasized, "right down to the entire engineering cycle of new devices."

"Subsequently, the end 'product' will be transferred to industries for commercial production. All this is taking place in the crucially important sector of optical fiber communications. Epitaxial deposition technology," he concluded, "will be the only valid technology in this field in 20 years' time."

## **Italy: CISE's LIDAR Developments, Applications Presented**

### **Atmospheric Surveying**

91MI0410A Milan NEWSLETTER CISE in English  
Jun 91 pp 5-6

[Text] For some time now CISE [Center for Data Studies and Experimentation] has been involved in various research programmes. One of these is for the development of new solid state (alexandrite, titanium-sapphire) and rare-earth (thulium, erbium, holmium, etc.) lasers with output radiation in the infrared band between 1,500 and 3,000 nm. The first two types can be used for measuring water vapor, temperature and atmospheric pressure, while the rare-earth lasers are very suitable for measuring wind speeds with Doppler LIDAR [Laser Infrared Radar] techniques. ESA (European Space Agency) is particularly interested in developing these types of laser, which it plans to use in the not-to-distant future for meteorological surveys carried out by satellites in polar orbit at an altitude of 800 kilometres. CISE research in this field is being financed by ENEL/CTRIN of Milan and by the CNR (National Research Council), which is more interested in land-based systems with a lower range (more than three kilometres) but greater accuracy. CISE is also constructing, still on behalf of ENEL [National Electric Power Company], a Doppler LIDAR system for measuring wind speed. This system, which will use a CO<sub>2</sub> laser of high spectral purity (300 kHz), will have a range of 20 kilometres and a sensitivity of one metre per second.

Another important area of research that at present is enjoying much popularity is the measurement and analysis of other components of urban air pollution, including not only the classic pollutants produced by heating systems and motor vehicles (ozone, sulphur, carbon and nitrogen monoxides) but also equally toxic combustion products such as aromatic polycyclics, which are at present not subject to controls.

Thanks to the experience of monitoring these substances gained in research campaigns financed by ENEL, CISE is now designing a mini-LIDAR for measuring them with fluorescence or absorption analyses techniques. This instrument follows the pattern of another compact mini-LIDAR fluorosensor, recently constructed with funding from IMI [Italian Institute for Financing Personal and Real Property]. Its small dimensions and low power consumption make it very easy and convenient to use as it can be transported on small vehicles.

### **Marine Surveying**

91MI0410B Milan NEWSLETTER CISE in English  
Jun 91 pp 5-6

[Text] CISE was awarded a contract by the Institute for Remote Sensing Applications of the EC Joint Research Centre to design and construct an airborne LIDAR

system for exploring the surface of the sea and identifying and measuring the presence of any pollutants, oil in particular, and concentrations of organic substances and chlorophyll.

The instrument is known as a LIDAR fluorosensor, operating on board an aeroplane or helicopter flying at an altitude of a few hundred metres. A short (about 1 ns) UV light pulse is generated by the laser and sent towards the sea surface. If it hits an oil slick or other substances suspended in the water, it excites their molecules and induces them to emit fluorescent light, which is picked up by a receiver telescope directed along the same axis as the laser pulse and then subjected to both spectral and temporal analysis. As the fluorescent emission of each molecule has its own emission spectrum and decay time (varying in the case of oil from 1 to about 30 ns), this dual analysis means that the type of oil or fluorescent substance can be recognized and evaluations made of the quantity present.

Some fluorosensors have already been in use for some time in various parts of the world, but this is the only type that enables a temporal analysis of fluorescence to be made over the whole emission spectrum with the necessary resolution (about 1 ns).

## MICROELECTRONICS

### JESSI Reports Development of 16 MBit EPROM Chip

91P60209 Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 25 Jun 91 p 8

[Text] The Joint European Submicron Silicon [Initiative] (JESSI) in Munich reports that, within the framework of the European JESSI program, an important milestone has now been reached with the first sample of a 16 MBit, electrically programmable read-only memory chip (EPROM). The chip was introduced by SGS-Thomson Microelectronics. Among other [applications] the chip is used for storing and, if need be, altering frequently used internal computer programs. A year ago already, Siemens had introduced the first sample of a 16 MBit dynamic random-access memory chip (DRAM). According to the JESSI board, the development of these two chips could be considered to "have caught up with the prime competitors on the world market." The JESSI program runs through 1996 and will begin its most critical phase next year.

### ICL Banned From Three JESSI Projects

91AN0355 Paris ELECTRONIQUE INTERNATIONALE HEBDO in French 4 Apr 91 p 11

[Article: "ICL Keeps One Foot in JESSI"]

[Text] Participation of International Computers Ltd (ICL) in the Joint European Submicron Silicon Initiative (JESSI), which was called into question since its takeover

by Fujitsu, has been reduced to two projects in the "applications" subprogram. At its latest meeting, the JESSI steering committee granted ICL a "guest" status. Several of ICL's partners had hoped to continue their cooperation with the UK firm. However, whether or not the decision gave rise to a closely argued discussion is not known, but ICL's contribution to three other projects under the same subprogram was nevertheless rejected. And even ICL's present guest status is granted, at least for the time being, only for the starting phase, during which the companies study only the technical feasibility of projects. This phase should be completed by the end of 1991.

The two projects in which ICL continues to participate are CAD-Frame and Euro-CAD. CAD-Frame involves a system supplying a standardized framework for computer-aided design (CAD) tools, which is not limited to electronic CAD and provides greater design and programming efficiency. It should serve as software basis for all CAD-related projects within the scope of both JESSI and the European Strategic Program for R&D in Information Technologies (ESPRIT). Euro-CAD's aim is to optimize the implementation of very-large-scale integrated (VLSI) components developed with JESSI tools and technologies in the design of printed circuits and multicircuit modules.

JESSI's funding problems, in particular that of EC Commission subsidies, also cropped up during this meeting. Indeed, commitments of about 7 billion French francs—one-quarter of JESSI's total budget between now and 1996—have not yet all materialized as ready money. In order to smooth out the difficulties, the committee has implemented procedures to supervise cooperation between industry and the authorities. Moreover, after rediscussing JESSI's overall strategy, it was decided to concentrate activities on some major projects as well as on meeting the most urgent user needs. Finally, the committee's president, Dr. Raimondo Paletto, and vice president, Dr. Ir. Sybrand Radelaar, were reconfirmed in their respective positions until the end of 1992.

### BRITE: Integrated Sensor Developed

91AN0467 Paris ELECTRONIQUE INTERNATIONALE HEBDO in French 6 Jun 91 p 22

[Article by Jacques Marouani: "The Sensor Finds a Place in Integrated Circuits"]

[Text] Research carried out at the School of Higher Studies in Electrical and Electronics Engineering (ESIEE) under the EC's Basic Research in Industrial Technologies for Europe (BRITE) project will soon make it possible to incorporate sensors and their environment into integrated circuits.

The integrated sensor is for tomorrow. Silicon-on-silicon bonding technology should allow a hybrid circuit containing a sensor and its associated electronics to be replaced by an integrated circuit and thus to achieve a miniaturized function better adapted to high-volume

production. Lionel Babadjian and Aziza Bounhir of the ESIEE are today (6 June) presenting papers covering just this technology in the school's facilities at Noisy-le-Grand.

The micromachined sensors currently produced generally consist of a silicon wafer bonded to a glass substrate. This method entails a loss of space and interface strains, since the silicon and the glass have different thermal expansion coefficients. These problems are eliminated, however, with the silicon-on-silicon bonding technology. It also makes it possible to produce much more complex structures than those obtained using glass.

Oxidation of the silicon wafers is carried out in a sulfuric acid bath containing hydrogen peroxide. This operation provokes surface oxidation of the silicon, and makes it hydrophilic (water adheres to the surface). After drying, the wafers are placed in contact, the polished sides facing each other, and a phenomenon of molecular adherence occurs. Thermal processing at 1,000 Celsius produces covalent bonds between the atoms of each surface, thus creating a true bond. In order to obtain a high level of efficiency and avoid unbonded segments, it is obviously necessary to work under valid conditions of cleanliness, i.e., in a class 1,000-10,000 clean room. ESIEE has produced an initial prototype. Tear tests conducted by Messerschmitt-Boelkow-Blohm (MBB) showed that it withstands a pressure of 100-300 bars. Electrical conductivity between the two wafers is close to perfect and the efficiency rate is higher than 80 percent.

Although the technology is there today, there will be no industrial production before 1994, according to Lionel Babadjian. The process is suitable not only for the production of sensors, but also for production of integrated microdevices such as movable-surface mirrors, resonators, or microengines. It is planned, for example, to monolithically integrate a sensor and an electronic temperature equalization function. After production of the micromachined sensor, it will be turned over to a silicon foundry to add the complementary function. Another approach would be to reverse the process, i.e., to "graft" the sensor onto the electronic function. This is riskier since it may entail destruction of the product. The silicon foundry will require only an infrared camera to locate the cavities. This integration technology could be used for acceleration sensors in active suspension systems of automobiles or for the manufacture of miniature pneumatic valves for robotics. Another project is reported to be the development of a silicon microengine. Lastly, the silicon-on-silicon bonding technology would make it possible to design pressure sensors small enough to be inserted into the human body.

#### **Research Funded 50/50 by the EC and the ESIEE**

This research, which started last year, first received the support of the French Ministry for Research and Technology. Since October 1990, it has been funded to the amount of 2.9 million French francs [Fr] — 50 percent by the EC and 50 percent by the ESIEE. It is part of a

three-year BRITE/EURAM [industrial technologies/advanced materials] project in which also participate MBB, Schlumberger, the Fraunhofer Research Center of Munich, and the National Microelectronics Center of Spain. Developments similar to the one at the ESIEE are also being carried out by IBM and Novasensor in the United States and by Toshiba in Japan. In addition, French companies such as Telemecanique and Schlumberger have expressed an interest in the silicon-on-silicon bonding technology.

#### **Belgium: MIETEC Establishes Submicron Production Plant**

91AN0477 Paris *ELECTRONIQUE INTERNATIONALE*  
HEBDO in French 13 Jun 91 p 10

[Article by Didier Girault: "Second MIETEC Plant in 1993"]

[Text] MIETEC, the European specialist in hybrid analog/digital application-specific circuits and a subsidiary of Alcatel, has just begun to build its second production unit in Oudenaarde, Belgium.

"The first module of our second production plant will be ready in 1993. Built to handle submicron complementary metal-oxide semiconductor (CMOS) and bipolar CMOS (BiCMOS) technologies (0.5 micron and below), it will have an annual production capacity of 60,000 silicon wafers 150 mm in diameter. Using a class-1 clean room, this module will have 1,200 m<sup>2</sup> in floor space (out of an anticipated total of 3,000 m<sup>2</sup>). The investment in this first phase amounts to 82.6 million European currency units [ECU] (578 million French francs [Fr])."

According to Jean-Pierre Liebault, general manager of MIETEC Alcatel, the new production plant should be sufficient to meet the expected demand during this decade: In all, an annual production capacity of 150,000 150-mm wafers will be added to that of the existing plant (160,000 100-mm silicon wafers). The overall investment is considerable, since "at the end of the second phase, the total will be \$400 million (Fr2.360 billion)," according to Jean-Pierre Liebault. To cover the cost, MIETEC is counting on its resources and on those of its shareholder Alcatel, as well as on an increase in capital. Although profitable since the middle of 1988, the firm is not capable of financing the necessary investment itself. Its sales in 1990 amounted to ECU67 million (Fr470 million); they increased by 55 percent compared to 1989 (growth reached 70 percent if based on dollar calculations). This year, sales should exceed \$100 million (Fr600 million), deliveries to Alcatel representing 70 percent of gross revenue. MIETEC is specializing in hybrid analog/digital circuits; they account for 50 percent of its sales. The company was ranked first in Europe and second in the world in 1990 (according to Dataquest). The production of hybrid circuits requires advanced technologies. This is why the Belgian firm, which since 1990 has been using 1.2-micron CMOS



technology, is developing this year an 0.8-micron range which should be in mass production in the new plant in 1993.

#### Sets of GSM-Based Circuits

An 0.7-micron technology is in the definition phase, as is the 150-V DBIMOS [as published] technology (instead of 100 V today); this is a high-voltage BiCMOS technology intended for line interface and industrial bus production. For low-voltage, high-density circuits (for telephone receivers), MIETEC will also introduce this year a 15-V BiCMOS technology; other technologies (10-V BiCMOS) will be offered for the manufacture of circuits based on the Special Mobile Group (GSM). Sets of GSM circuits will be on sale beginning in 1993, when the second production plant is operational. "We are already selling circuits for consumer goods to Japan and Taiwan. Our growth in Japan is based on our expertise in hybrid technologies; this is of relatively less interest to the United States, which are above all active in computing," says Jean-Pierre Liebault.

#### Belgium: IMEC Activities Reviewed

91ANO383 Zellik *TECHNIVISIE* in Dutch 3 Apr 91 pp 12-14

[Article by Eng P. Pype: "Rapids Have Not Yet Slowed Down"]

[Excerpt] [passage omitted]

#### IMEC Plays Key Role in Flanders and Europe

IMEC (Interuniversity Microelectronics Center) was established in 1984 and has been fully operational since 1988. It currently employs 420 people and in 1990 its contract research amounted to 548 million Belgian francs (BFR). IMEC's objective is to perform research which anticipates the needs of industry by five to 10 years and to improve the industrial climate in Flanders.

Because IMEC has only been operating at full capacity for the last 3 years, the impact is only just beginning to be felt. At the moment, IMEC has more than 40 specific joint projects with Flemish universities. Two significant examples are the development of optical thyristors with the Free University in Brussels (VUB) and the development of a security chip with the Catholic University in Leuven (KUL) and Cryptech.

In 1991, it is estimated that bilateral cooperation projects with Flemish companies will amount to more than BFR90 million. There is also indirect cooperation with many more companies via the advanced technical engineering institutes. Many companies prefer to cooperate closely with local engineering institutes which, in turn, use software and hardware made available by IMEC.

IMEC is in a fairly unique position compared to similar initiatives abroad. No other research laboratory abroad achieves such a large turnover from research contracts

and foreign institutes usually receive considerably more government aid. Furthermore, the interuniversity aspect and the close cooperation with universities, advanced technical engineering institutes, and companies is unfamiliar to foreign laboratories.

#### Attracting And Starting Up Companies

In addition to the many joint projects, IMEC is also involved in attracting foreign companies to Flanders. The presence of a significant technological potential is often a decisive reason to opt for Belgium as a site. Not only are the opportunities for technology transfers considered, but also considered is the possibility of recruiting highly qualified personnel.

Foreign companies that, mainly because of this technological potential, have established their European base in Flanders are: Olin Hunt, Allied Signal, BOC, and Bales.

In addition, several new companies have been set up, for example: Cobrain (plasma etcher), Solltech (solar cells), UCB Electronics (photoresist), and EDC (design software).

#### Key Role for Design and CAD

Due to the increasing complexity of chips, the design and use of appropriate software are gaining momentum in marketing new electronic products. In this field, a real expert center has emerged in Leuven. At the present time EDC (European Development Center) is in operation of which Mentor Graphics (the largest U.S. electronic CAD [computer-aided design] manufacturer), Philips, and IMEC are shareholders.

IMEC's research groups develop new software which is further developed by a Design Methodology Transfer group. Industrial residents (company people brought together at IMEC to carry out scientific research or acquire design knowledge) are able to apply the initial software versions in order to become familiar with the software and to obtain a lead on competitors with regard to the use of integrated circuits. Subsequently, the software is further developed, made more user-friendly, and marketed by EDC, who puts the CAD software on the market.

Thanks to the presence of system knowledge at the Leuven University and IC design and CAD expertise within IMEC, Philips recently established ITCL (International Technology Center Leuven) in Leuven to synergistically use general knowledge for developing prototypes of future products.

Currently, the impact of research that began 10 years ago, which at the time was considered to be elitist and not directed toward our industry, is definitely finding its way into our industry. It is clear that the microelectronics section of the Third Industrial Revolution in Flanders (DIRV) project has a stronger impact on the Flemish and European business community, than could have been predicted at the time.

**Thomson, SGS-Thomson Open Joint Semiconductor Research Center**

91AN0474 Paris *ELECTRONIQUE INTERNATIONAL*  
HEBDO in French 13 Jun 91 p 2

[Article: "Thomson Finally Seeks Synergy Between Consumer Electronics and Semiconductors"]

[Text] Thomson Consumer Electronics (TCE) and SGS-Thomson Microelectronics have just announced the creation of a joint semiconductor research center, Thomson Consumer Electronic Components (TCEC), with the aim of integrating more efficiently the design of consumer electronic products and that of the semiconductors they contain. The task of TCEC, which will be operational as of 1 July, will be to develop, in the broad sense of the term, all the components necessary for the manufacture by TCE of the new generations of consumer equipment, particularly in the high-definition television or multimedia fields. Along with this creative process will come an alignment of supply procedures; it would be legitimate to ask why this was not done before, Thomson being one of the few electronics groups not to have taken advantage of the synergy between its various subsidiaries. TCE is thus anticipating that it will receive 50 percent of its supplies from SGS-Thomson in 1995 as compared to only 9 percent today. At first, TCEC will be located in Grenoble, with its own premises and a staff of 90 (50 percent TCE, 50 percent SGS-Thomson). At the end of 1992, the center should employ more than 200 people, mostly engineers, in new independent premises on the site of "Grenoble 92" (a joint SGS-Thomson National Center for Technical Research (CNET) project for the development of submicron technologies) at Crolles in the Isere region.

TCEC's annual operating budget will be 90 million French francs (Fr) at the outset and will reach Fr200 million once it is functioning.

Commenting on the announcement that the center would be created, Bernard Isautier, managing director of TCE, stated: "The creation of a joint research center for integrated circuits will allow TCE to reduce the cost and development time of its products. The other advantage of this initiative will be to bring teams which are currently dispersed together within one organization. Finally, for TCE it corresponds to the wish to carry out more efficiently the programs it is undertaking as part of its high-definition television (HDTV) contract with the French Government." For his part, Pasquale Pistonio, CEO of the SGS-Thomson group, added: "We expect it to lead to an expansion of the range of components intended for all consumer electronics."

Moreover, the acquisition of a captive market worth \$250 million—the amount of purchases made by TCE—will certainly not do any harm to the French/Italian company, which was to resume discussions with Siemens at the end of the month with the aim of finding a solution to European cooperation on semiconductors.

**France: Thomson Increases Hybrid Circuit Density**

91WS0347A Paris *INDUSTRIES ET TECHNIQUES*  
in French 5 Apr 91 p 34

[Article by Ridha Loukil: "Denser Hybrid Circuits Than Ever"; first paragraph is INDUSTRIES ET TECHNIQUES introduction]

[Text] Multilayered thin-film circuits, co-annealed at low temperature, 3D chip interconnection. Hybrid circuits counting on density to attract more users. Seen at the Hybrid Microelectronics Forum in Paris.

To better parry the combined thrust of surface-mounting and application-specific integrated circuits [ASIC's], hybrid circuits are pursuing the strategy of mounting more chips on the same ceramic substrate. With a view to enhancing their appeal to traditional users (military, space, and telecommunications) and attracting potential new users in industry and the consumer-electronics sector, they are now adding another strong card to this method of interconnecting chips, known for its advantages over printed circuits from the standpoints of miniaturization, reliability, and heat dissipation: density. The Hybrid Micro-Electronics Forum, held in Paris on 12-13 March, where the dominant theme was the opening of new doors, reflected this trend.

Layered hybrid thin-film circuits, the most advanced approach to circuit integration, have progressed from a single-layered to a multilayered technology. Thomson has invested 100 million francs [Fr] in the development of a 5-layered technology. An automated production line is being installed at Massy. Philips in Belgium, Contraves in Switzerland, and Raychem and Polycon in the United States, are industrializing similar technologies. The Thomson circuit is formed by depositing five copper or aluminum conducting layers, separated by polyimide insulating layers, on an alumina substrate. The manufacturing process involves techniques used in the integrated circuits [IC] industry, such as vacuum deposition, lithography, and etching. With a 50-micron interconnection lead at present, that is soon to be reduced to 25 microns, the dimension of the in/out leads of present-day chips, its performance characteristics actually border on those of IC's. This is why this technology is being addressed initially to top-of-the-line applications. The U.S.-based Teledyne company is developing it exclusively for Boeing. IBM uses it for airborne data-processing applications. And it is a domain that interests Siemens.

**20 Ceramic and Conductor Layers Annealed Simultaneously**

Multilayered thick-film circuits, in which the conductor layers are formed by screen-printing, can be made denser through the use of 125-micron paths, in lieu of the customary 250 microns. The manufacturers are contemplating 6-layered circuits using this technology, which, according to Dassault Electronique, resolves 30 percent

of the problems at a cost 30 to 50 percent below that of multilayered thin-film circuits.

Low-temperature co-annealing, a technology developed by Du Pont de Nemours, enhances the density-related advantages of the thick-film technology. Thomson and Sorep, which have invested in this approach, envision up to 20-layer circuits with, to boot, a simpler and faster process. The circuit is formed by superposing sheets of un-fired ceramic, on which conductor layers have been deposited by the screen-printing method. It is then pressed together and annealed in a single operation. By way of contrast: In the conventional thick-film technology, the circuit is built up layer by layer, each layer requiring a separate annealing operation.

Another promising approach is 3D interconnection. Together with the National School of Chemistry at Clermont-Ferrand, Thomson has developed a technique that promises a density leap by a factor of five to 10. The principle consists of stacking up to 10 blank chips, interleaved with epoxy layers in alternating sequence. The interconnection is formed by chemical deposition and laser etching. The U.S.-based Texas Instruments and Irvine Sensor companies, the sole world specialists in 3D interconnections, achieve the same results by juxtaposing the chips vertically on a silicon substrate. Irvine Sensor is using this technology for the military. And Texas Instruments is developing it for memory modules. As experts in miniaturization, the Japanese are eyeing Thomson's technology with considerable interest. Dassault Electricite, however, reproaches the technology with serious repair difficulties it has encountered; and with a view to eliminating these problems, Dassault is developing a technology of its own, which it has not disclosed as yet.

#### France: CNRS Develops Conducting Polymer

91AN0365 Paris SCIENCES & Avenir in French Apr 91 p 13

[Text] Television screens that can be rolled up like posters or pocket calculators that can be crumpled like handkerchiefs.... That is to be made possible by the first all-plastic transistor developed by the National Center for Scientific Research (CNRS) laboratory for molecular materials at Thiais. For several years, Francis Garnier and his team have been working on conducting polymers. Today, they have succeeded in formulating a thiophene-derived organic polymer that could be used to replace amorphous silicon in electronic components. "With soft transistors, one might even envisage production of foldable radio sets, apart from the loudspeakers!," explains Francis Garnier.

In France, Thomson and the National Center for Telecommunications Studies (CNET) are of course interested in the work done in Thiais. The size of the new transistors still remains to be divided by 10 to reach the miniaturization level of present components. Francis

Garnier appears optimistic: "In principle, this is perfectly possible, all we will have to do is to associate ourselves with specialists in microetching."

If all goes well, the first industrial samples should appear in 3 years. As for mass production of soft components, the ball is in the manufacturers' court.

#### Siemens Develops 0.3-Micron Lithographic Process

91AN0411 Paris ELECTRONIQUE INTERNATIONALE HEBDO in French 25 Apr 91 p 27

[Article signed F.F.: "Siemens Pushes Back the Limits of Optical Lithography"]

[Text] A lithographic technology developed by Siemens for amplifying the geometric forms before etching the pattern onto the wafer produces a finer resolution than that offered by wafer stepping equipment.

Siemens has recently developed a lithographic process that allows finer patterns to be etched on a wafer than the resolution limit of currently used optical lithography systems. The process has been dubbed CARL for Chemical Amplification of Resist Lines. With excimer laser wafer stepping equipment operating at a wavelength of 248 nanometers and a digital aperture of 0.5, it is possible to obtain a focal depth of approximately 1 micron for a resolution limit of 0.25 micron. Due to the distortion of the wafer and its surface curvature, the focal depth that can be used under production conditions is substantially less than 1 micron. The focal depth which is needed for reproducing the mask pattern is less than the thickness of the required photosensitive resin, which must be at least 1 micron because of the topography of the substrate and because of the erosion of the resin film during the etching process. Consequently, it is not possible to guarantee the exact reproduction of the mask pattern through the entire thickness of the resin. Under these circumstances, Siemens considers that excimer laser wafer steppers will not be instrumental for producing 0.25-micron patterns with conventional resins on an industrial scale, although that is what they are intended for.

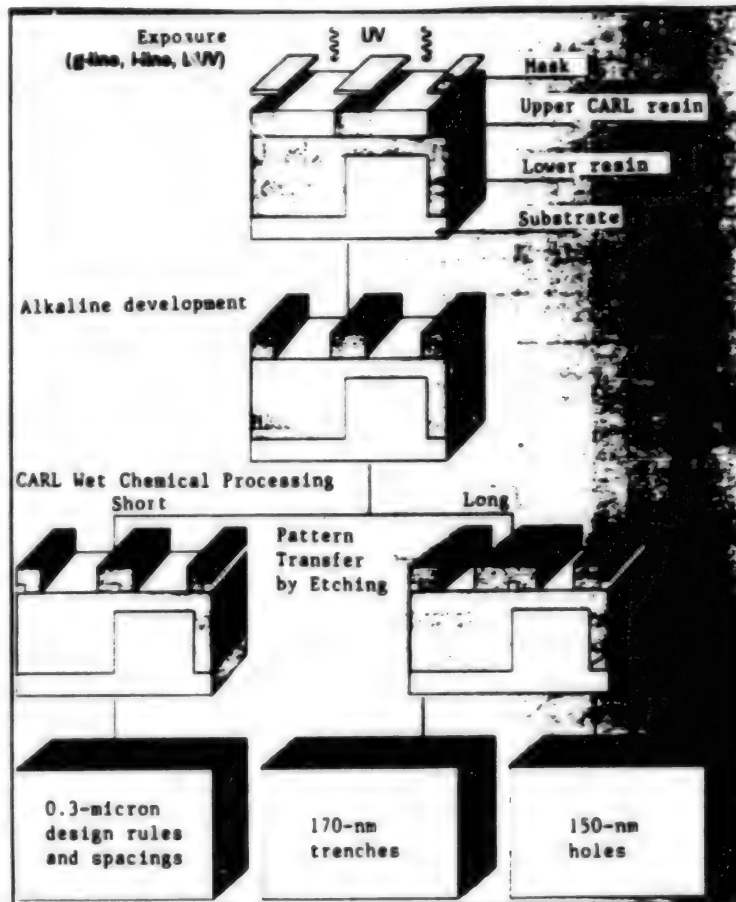
The dual-resin technology constitutes a plausible alternative for overcoming this obstacle since it separates the focal depth and photoresist problems. With this method, the substrate is first flattened by the deposit of a 1-micron-thick film of organic material which is not photosensitive. A 0.3-micron-thick photosensitive resin containing silicon is then deposited on top of the structure. Since the thickness of this upper resin is less than the focal depth achievable with a wafer stepper, good definition of the pattern throughout its thickness is guaranteed.

#### Wet Chemical Processing

After exposure and development, the patterns in the silicon-containing photosensitive upper resin serve as an



### CARL Process Upgrades Wafer Stepper Performance



Using a 0.45-micron-resolution "i-line" wafer stepper and extended CARL processing, 170-nm trenches and 150-nm holes have been produced in the lower, 1.8-micron-thick resin, thus achieving a 10:12 height-to-width ratio. Such design rules could previously only be achieved by electron beam lithography—a much more elaborate method.

etch-resistant photoresist to ensure pattern replication into the subjacent resin by oxygen plasma etching. The subsequent transfer of the pattern onto the substrate and the stripping of the second resin is the same as for the single resin film method. However, the dual-resin method has a resolution limit of under 0.5 micron, since a reduction in the pattern widths in the two resins is unavoidable during the aggressive oxygen plasma transfer. It is not possible to transfer the pattern of the upper resin to the lower resin without a loss in linewidth. For a resolution of less than 0.5 micron, pattern width losses exceed the permissible tolerances and cannot be reliably controlled.

The only way to compensate for this loss in linewidth is to increase the pattern width in the upper resin. Until now, this has not been possible with conventional lithographic methods without resorting to a different mask. That is where the CARL process developed by Siemens comes in. The amplification of the pattern widths in the upper resin is obtained via a wet chemical process. This

process can be applied on any lithographic process line and requires no additional investment in equipment. Using a 0.35-micron-resolution excimer laser wafer stepper, Siemens has succeeded in producing 0.3-micron patterns in a reliable way. The German manufacturer plans to produce 0.2-micron patterns with the next generation of this type of wafer stepper. Accurate control of pattern amplification during the CARL process, which can last from 10 to 80 seconds, makes it possible, for the first time, to reduce the size of resin trenches and holes to well under the resolution limit of the optical equipment employed.

### Kaiserlautern Scientists Develop X-Puter

91P60180 Frankfurt/Main FRANKFURTER  
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT  
in German 28 May 91 p 8

[Text] X-puter is the name of a new computer concept for parallel computing, developed by Professor Reiner W. Hartenstein and his colleague at the computer science

department of the University of Kaiserslautern. This computer uses electrically programmable logic components instead of a program storage device as in conventional computers. The X-puter program consists, not of instructions called up from a program storage device, but rather of interconnection lines. They are configured upon an arithmetic logic unit (ALU) chip, prior to initiating computations.

Thus, the ALU is not hardwired but can be configured as powerful linked operators. In this way, the scientists achieved parallelism within a single processor. This parallelism at the lowest level should make the X-puter much more efficient than conventional computers. Allegedly, hundredfold to thousandfold improvements in performance were achieved in Kaiserslautern through the use of parallel algorithms.

This is apparently due to smaller internal management costs, compared to computer programs. The boost in performance applies to algorithms from important fields such as signal and image processing and medicine. Here, the X-puter should achieve a level of performance comparable to highly integrated special components such as ASICs. However, in contrast to ASICs, the X-puter is universally programmable.

Up to now, one prototype has been built in Kaiserslautern. In the future, Hartenstein hopes to further refine the relevant techniques, languages, programming techniques and the hardware. Reportedly, this will make possible an even higher level of performance, using less expensive hardware. Development of the X-puter is taking place against a backdrop wherein one needs to consider that computers nowadays embody a more or less "bottleneck structure." Since the predominant portion of the computer's capacity is used for managing I/O devices and memory, the processor gives rise to excessive management costs. Furthermore, as stated by the scientists from Kaiserslautern, parallel computers have not completely resolved this problem. Of course, the processors—hooked up in parallel—of parallel computers currently in use make possible parallel computations at a high level. But, not all problems can be resolved into partial tasks; thus, individual processors are simultaneously filled to capacity. Moreover, coordination of the processors leads to internal management costs. For this very reason, the computers would not be able to achieve in practice the level of performance that is theoretically possible.

#### Germany: Microsystems R&D at MBB Outlined

91MI0403 Munich MBB NEW-TECH NEWS  
in English No 1/91, 1991 pp 27-29

[Article: "Integrated Optics: Thin-Film Interferometers and Color Sensors Illustrate the Potential of Microsystems Technology"; first paragraph is MBB NEW-TECH NEWS' introduction]

[Excerpts] Manufacturing procedures derived from semiconductor technology have made it possible to produce microoptical structures on silicon that enable light to be guided and detected. As a subsector of microsystems technology (MST), microoptics opens up new dimensions in miniaturization, stability, complexity and flexibility in contrast to conventional, discrete optical assemblies. Described below are sensors that are optically read out to obtain physical and chemical parameters along with a classification system to effect spectral differentiation between liquids. These examples represent the multitude of applications the Integrated Optics sector offers, and they illustrate how extremely efficient systems can be realized by combining MST components with sophisticated information-processing procedures (neuronal networks). [passage omitted]

The backbone of all developments in the Microsystems Technology Department at MBB of Munich consists of two clean rooms with a total gross area of approximately 1,000 m<sup>2</sup>. In these rooms it is possible to produce electronic CMOS circuits (complementary metal oxide semiconductor), and micromechanical and microoptical components.

The basic functions of microoptics, which is per se a domain of III V semiconductors, include generating light with lasers or LEDs (light-emitting diodes), guiding light via multilayer structures, and detecting light via photodiodes.

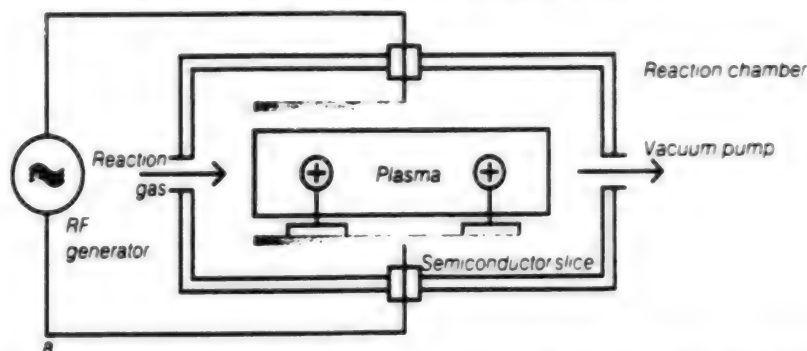
The base material used at MBB for microoptics is silicon, as is also the case for microelectronics and micromechanics. For the moment, single-crystal silicon is less suitable for microoptics because of its indirect and fixed energy gap. However, interesting applications become possible when dielectric and semiconducting thin films are deposited on top of silicon wafers.

Studies conducted at MBB have shown that dielectric films suitable for use as light guides or for the production of photodiodes can be deposited at temperatures below some 350°C onto singlecrystal silicon wafers. Such wafers may already contain microelectronic circuits. The procedure used to integrate these amorphous films is called plasma deposition.

In this procedure, two electrodes that are fed by an RF generator are positioned parallel to one another in an evacuated reaction chamber. The semiconductor wafers that will receive the deposits are mounted on one of the two electrodes. As soon as suitable process gases flow between both electrodes, a glow discharge occurs in which the gas molecules are broken up into chemically reactive species that serve as precursors for the films to be deposited. Silane (SiH<sub>4</sub>), for example, can be used as a process gas to produce amorphous silicon photodiodes. Dielectric, light-guiding films, on the other hand, can be obtained by diluting SiH<sub>4</sub> with laughing gas (N<sub>2</sub>O).

In order to produce light-guiding films, multilayer structures with various refractive indices must be made. Consequently, for example, a 2-to 3-μm-thick SiO<sub>2</sub> film with a refractive index of  $n = 1.46$  can be formed on the

The so-called plasma deposition technique is used to integrate amorphous semiconducting and dielectric films onto crystalline silicon. By varying the composition of the reaction gases admitted into the chamber one can vary the films that are to be deposited onto the surface of a wafer.



surface of a silicon wafer. And, also using the plasma-deposition procedure, dielectric films can then be deposited onto that film. These dielectric films could, for example, consist of silicon oxo-nitride (SiON) and a refractive index of  $n = 1.50$  to  $1.52$ . It is possible to guide light waves in a film structure of this kind.

The advantages and potential of microsystems technology can be seen in the example of an integrated optical pressure sensor. In this system, structures from micromechanics, microelectronics, and integrated optics are all found on one single silicon chip. The most important component of this system is a several-millimeter-large membrane that is structured with the aid of micromechanic methods. On top of the membrane is a part of an interferometer which was produced using a light-guiding film.

In order to couple light into the interferometer, an etched V groove is put into the left side of the chip that is just large enough to receive a light fiber. A photodiode integrated on the opposite side serves to detect the light that is coupled into the interferometer. An electronic amplifier and analysis unit can also be integrated into the same chip.

When hydrostatic pressure is applied to the membrane, the refractive index of the strained interferometer arm changes relative to the unstrained one. What occurs then is a change in the upper light path relative to the lower one, which induces a phase difference between the two light waves. Variable pressure on the membrane produces interference at the photodiode that is alternately constructive and destructive. This is how a pressure sensor is made that can be optically read out, and which functions inherently digitally and incrementally.

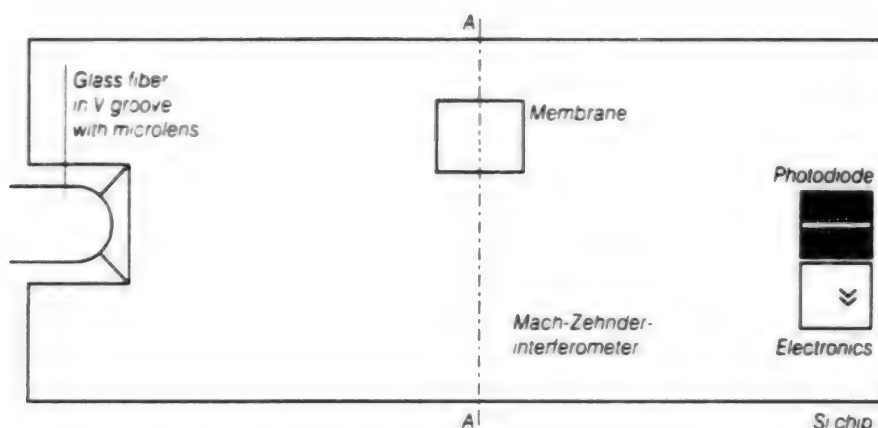
As an alternative to a thin membrane, chemically active media can be deposited onto one arm of the interferometer. Such media adsorb certain gas molecules from the air enabling, for example, air pollutants to be measured. With this principle, too, measuring gas molecules is based on an adsorption-induced change in the effective

refractive index with resultant interference effects. However, although such gas sensors are generally very sensitive, they never provide conclusive identification of the signal-producing molecules.

Because of this, a whole series of sensors with various adsorber films have to be produced in parallel and exposed to certain gases under controlled conditions. The sensors produce various output signals depending on the gas adsorbed. The output signals are in principle vectors that can be read into an intelligent computer system for learning purposes (for example neuronal networks). If such a sensor array is exposed to real environmental conditions, various values will be measured. Since the computer system has learned so much in the training phase it can now reliably identify situations and provide the appropriate display.

Another activity in MBB's Microsystems Technology Department consists of producing so-called multilayer diodes where both crystalline and amorphous silicon are used at the same time. The advantage here is that semiconducting films can be realized, each with different spectral characteristics, on one common base material. It is therefore possible to produce photodiodes in crystalline silicon and an amorphous silicon photodiode with transparent entrance and exit windows on top. As soon as light enters into this structure it is absorbed by the amorphous silicon film.

Since with increasing wavelength the amorphous silicon diode can no longer absorb all the light, it converts the absorbed part of the light into an electric signal and transmits the non-absorbed part of the light to the crystalline silicon substrate, which in turn also produces charge carriers. In other words, both diodes generate electric signals in competition with one another. What this competitive situation is like depends on the wavelength of the incident light. When tuning the monochromatic light towards longer wavelengths, it becomes evident that the amorphous silicon diode absorbs less and less light in comparison to the crystalline silicon photodiode. The ratio changes exponentially with the wavelength.



The integrated optical pressure sensor shown here contains structures from micromechanics, microelectronics and integrated optics on one common silicon chip.

Photodiodes are capable of identifying and differentiating between light sources by their spectral characteristics. For example, the ratio resulting from a diode exposed to daylight is different from the one induced by the light of a light bulb or of a tubular fluorescent lamp. The distinction can also be made between flame and daylight, which is especially interesting for detecting fires. With the help of a fire sensor, fires can already be combatted in their initial stages.

Based on the principle described above, MBB scientists have made a high-resolution color sensor which in monochromatic light reaches a spectral resolution better than 1 nm. Consequently, this sensor can detect over 100 shades of red, which is far more than the human eye can distinguish. This color sensor is the heart of a system designed to classify liquids.

Basically, this system consists of the actual color sensor (three integrated photodiodes), a source of light, the electronic system, and a personal computer (PC). Between the light source and the diodes are exchangeable containers filled with liquid test specimens. Depending on their optical characteristics, the test specimens absorb part of the incident light and transmit the non-absorbed part of the color sensor.

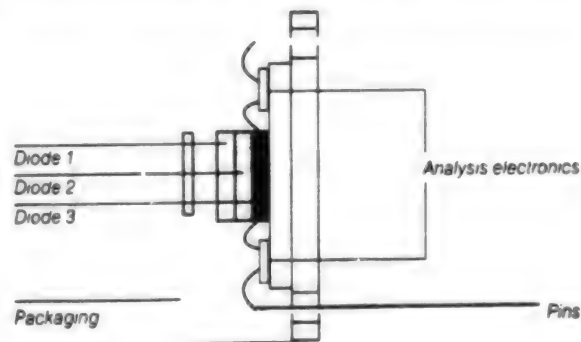
Depending on the specimen, the color sensor generates a signal vector consisting of three components (gray values), which is transmitted to a computer system (neuronal network). The computer's task is to compare the ascertained signal vectors with data previously learned in a training phase and to produce a reliable statement on the composition of the liquid test specimen. In a trial demonstration the system rapidly identified various red wines that are indistinguishable with the human eye alone. This further illustrates the high spectral resolution of the color sensor.

Such a system could be utilized for almost any number of applications. In medical technology, for example, various blood counts (blood sugar, cholesterol, etc.) could be effectuated, or color-change reactions could be studied and highly sensitive verifications performed in the chemical industry.

The color identification system could serve well in metal-processing companies. In this case it could analyze the concentration of iron in waste water to make sure certain maximum values are complied with. And the textile industry, where materials are tested for color, could also benefit from this system.

In addition to purely static measurements, the short response times of the photodiodes also allow dynamic measurements to be made (microsecond range) in which continuous procedures are measured.

#### Spectral response curves of amorphous and crystalline silicon.





**Ex-GDR Company Offers Submicron Technology**  
91AN0387 Paris *ELECTRONIQUE INTERNATIONALE*  
HEBDO in French 18 Apr 91 p 9

[Text] Can an ex-GDR semiconductor equipment manufacturer survive? The answer to this question is due by the end of May. The status of Jenoptik Carl Zeiss Jena GmbH is yet unclear. It strives to obtain a "raison d'être" in association with Carl Zeiss Oberkochen, its sister company established in West Germany after the country had been divided and with which it already has some cooperation agreements, without however losing its own identity. Treuhand, the ministerial department in charge of privatizing ex-GDR companies, is indeed considering several options which are basically either a straightforward takeover by Zeiss or a sharetaking by the Thuringia Federal State. Jenoptik's survival is crucial to the Jena region. And yet, in order to be competitive and win credibility with potential customers, the company would have to restructure, adopt new strategies, and scale down its workforce from 27,500 to 5,000 people.

Nevertheless, its technological know-how in the sector is impressive. It has just proven so to the West by presenting a range of high-performance wafer steppers which can produce 0.6-micron structures with a resolution of 0.1 micron. (see box)

**Protecting Its Know-How**

The performances of Jenoptik's instruments should come as no surprise. In its heyday, the ex-GDR recognized the strategic importance of microelectronics as a key technology for the future. Having to develop its own semiconductor manufacturing equipment because of COCOM rules forbidding foreign supplies, it heavily subsidized microelectronics and all related technologies. The Carl Zeiss Jena combine, and especially the Jena-based plant which produced precision optics equipment, bore the main responsibility for developing the appropriate machinery. The quality of this equipment certainly contributed to the ex-GDR's capability to produce fairly large batches of 1-Mbit dynamic random-access memories (DRAMs), prototypes of 4-Mbit DRAMs, as well as gate arrays and 16-bit microprocessors. At a time when dependence on Japanese suppliers of semiconductor equipment is ever more criticized, protecting that know-how appears imperative. Treuhand is presently holding 80 percent of Jenoptik, the remaining 20 percent being owned by the East German Carl Zeiss Foundation. Having disappeared during the 1948 nationalizations and now revived for the purpose, the Foundation is managed by the Federal State of Thuringia, which is negotiating with Treuhand for a total takeover of Jenoptik, whereas the company's employees and unions want the West German foundation to take a majority share.

**[Box]**

**Third-Generation Wafer Steppers**

Exhibited at both the SPIE Conference on Microlithography and at the Zurich Semicon exhibition, Jenoptik's

ASR wafer stepper line features g- and i-line machines. Some of them have been sold for some 10 years in East European countries, mainly in the Soviet Union. Latest model to date, the ASR-23 also has the highest performance. Being of the i-line type, it can produce 0.6-micron structures with a 0.1-micron overlap accuracy. It can process 150-mm wafers and requires a class-10 cleanliness level. This high-grade equipment can be used to produce 16-Mbit DRAMs!

**Germany's Parsytec To Develop TeraFlop Computer**

91AN0386 Paris *ELECTRONIQUE INTERNATIONALE*  
HEBDO in French 11 Apr 91 p 24

[Article by Elisabeth Feder: "Parallel Architectures: Parsytec Aims At TeraFlop Machine"]

[Text] The German Parsytec company claims to be capable of designing a massively parallel transputer-based computer with a performance of 1 teraflop (1 trillion floating-point operations per second) by 1993. The company has just suggested to the European TeraFlop Initiative (ETI) to develop such a computer for some \$25 million—i.e., the cost of a current Cray-type supercomputer—within the framework of a multipartner industrial consortium including Inmos, the inventor of the transputer, the Dutch software company ACE, and an Italian team led by the physicist N. Cabibbo of Rome University. Since its creation in 1985, Parsytec has been specializing in the development of transputer-based parallel computers.

**65,536 Computing Nodes**

The core of the machine currently under study will consist of as many as 65,536 H1-type processors, which will officially be introduced by Inmos before the end of the month and should be available by 1992. It should be recalled that ETI was launched on the initiative of a group of European physicists and experts in scientific data processing with the goal of introducing a European-designed 1-teraflop machine to the market before 2000. Jacques Delors, president of the European Commission, and Carlo Rubbia, director general of the European Center for Nuclear Research (CERN), submitted the results of a preliminary study in Brussels.

The Parsytec project is based on the multiple instructions multiple data (MIMD) concept, as opposed to the single instruction multiple data (SIMD) concept (Cray Research, for instance, is also working on a MIMD project).

The 65,536 "computing nodes" are interconnected according to a homogeneous structure. Each node is in fact a genuine small 64-bit computer; it operates on its own and communicates with its neighbors, if necessary, by a message transfer logic. The memory is distributed. The number of computing nodes in a MIMD machine is practically unlimited. According to Dr. Falk Langhammer, head of the TeraFlop project at Parsytec, the

transputer is the sole component to allow a "simple" and, at the same time, economical implementation of the project at this time. The reason is that it combines, on a single chip, a RISC [Reduced Instruction Set]-type 32/64-bit processor as well as a few kilobytes of local memory, various links for communications with other transputers in the network, and system functions such as multitask management. The Inmos H1 component has a scalar performance of 25 Mflops.

Other features that need to be mentioned are the 80-Mbyte/second passband on the communication links, the 16-kbyte integrated memory, the 200-Mbyte/second passband on the memory ports, and the 64-bit data buses. In order to implement a computing node, it is sufficient to add a few memory components to the core made up of the transputer. Hardware-wise, each node will thus be completely identical. It therefore hardly matters whether a program is run entirely on a single transputer or in segments on several transputers.

According to simulations, a machine with a 65,536-transputer network can handle  $1.3 \times 10^{12}$  floating-point operations per second, i.e., 1.3 teraflops.

## NUCLEAR R&D

### Germany: Juelich Research Center Develops Improved Plasma Heating Antennae

91MI0421 Bonn TECHNOLOGIE NACHRICHTEN-MANAGEMENT INFORMATIONEN in German 13 Jun 91 p 9

[Text] Considerably simplified antennae have been developed for the high-frequency heating system of the TEXTOR nuclear fusion test plant at the Juelich Research Center. This success is attributable to a team of Belgian scientists involved in research at the Juelich TEXTOR plant. Apart from its importance in terms of pure physics, from a practical point of view these results could represent a major step forward in the simplification of future reactor antennae.

The aim of controlled nuclear fusion research is the generation of energy via the fusion of hydrogen to helium. At the Juelich TEXTOR test reactor, the plasma is confined by setting up a strong magnetic field and the requisite high plasma temperatures are achieved by special heating processes. These include the use of electromagnetic waves close to ion cyclotron frequency, known as ion cyclotron resonance heating (ICRH).

Since 1981 there has been an agreement on cooperation between the Juelich Research Center and the Plasma Physics Laboratory at the Royal Military Academy in Brussels (EURATOM/Belgian state association). Under this agreement, the Brussels team has installed an ICRH system in TEXTOR and has been running it successfully for several years.

ICRH heating requires the installation of large antennae inside the Tokamak vacuum chamber near the perimeter

of the plasma, to feed a high frequency output of several megawatts into the plasma. The antenna is the most complex element in the whole ICRH system. It consists of one or more conductors that carry the high frequency current used to generate the electromagnetic waves. The conductors are situated in a protective housing with a Faraday cage—a protective grid—on the side facing the plasma. The Faraday cage acts as a sort of polarizer; it allows through only waves with the right properties for plasma heating. It also protects the antennae from the hot plasma. For various technical reasons, the actual construction of this cage is difficult and expensive. Dispensing with a Faraday cage would thus considerably simplify the operation of the next generation of major plants.

Meanwhile, the modern coating processes developed at the KFA [Nuclear Research Center] ensure that the plasma in the current Tokamak is extremely pure, and the interaction of the plasma with the wall components is only minimal.

In light of these considerations and the new knowledge (acquired in recent years) of the mechanism responsible for the interreaction between the antennae or screening and the ablating plasma, the role of the Faraday cage was reassessed by the Belgian team. It was thus established that, as a very good conductor in the direction of the Tokamak magnetic field, plasma itself can filter out the undesirable waves just as effectively as a Faraday cage, and with no detrimental effects. Tests with an unscreened antenna of this type proved successful in every respect and gave the same level of heating in the TEXTOR as normal antennae with screening.

### German Hadron Electron Accelerator Ring Stores First Protons

91MI0378 Bonn WISSENSCHAFT WIRTSCHAFT POLITIK in German 22 May 91 pp 4-5

[Text] Protons have now been successfully stored for the first time during the gradual entry into service of the new accelerator at the German Electron Synchrotron (DESY) - a significant milestone that demonstrates the operational efficiency of the HERA hadron electron ring accelerator's superconductive proton storage ring. (Protons belong to the group of elementary particles known as hadrons.) After flying through a chain of preaccelerators, in which the protons are grouped into small bundles and their energy is gradually increased, they have for the first time been steered into the HERA ring.

Several times during this test run, a single bundle of protons was successfully circuited in HERA. Each bundle has an intensity of between 100 million and 10 billion protons, and a maximum "life span" of 30 minutes was recorded, which meant that half the particles stored were still present after 30 minutes. The purposes of the proton storage ring's first test run were to bring a number of technical components into service and to



store a proton beam in HERA, thus provisionally determining important parameters for the accelerator. It was successful on both counts.

The next stage will consist of the first test on HERA's superconductive high-frequency acceleration sections, which complement its normally conductive sections and are needed to accelerate the electron beam to the desired energy of 30 billion electronvolts. HERA's gradual commissioning of HERA will continue until fall of this year. In early November, the two large demonstration units "H1" and "ZEUS" will be brought into the accelerator and connected up, so they will be able to measure the first electron-proton collisions in HERA before the end of this year. HERA is a unique new large-scale facility for research into elementary particles, where 700 physicists from all over the world will carry out research into what are termed deep inelastic electron-proton collisions at the German Electron Synchrotron. The electrons and protons circulating in HERA at almost the speed of light are brought together at two points, where they collide at high energy, thus permitting experimental research into structures measuring as little as 0.000,000,000,000,000,1 meters. These physicists hope to extend their knowledge of the microcosm, the structure of matter, and fundamental forces. HERA is the first accelerator to store and bring different types of particles into collision: electrons (which form the outer layer of all atoms) and protons (which are components of all atomic nuclei). The 6.336 meter long subterranean tunnel contains two storage rings, one on top of the other, in which the electrons will be accelerated to an energy of 30 gigaelectronvolts (GeV), and the protons to 820 GeV. Owing to its high energy, the proton beam is held and focused on the track with 646 superconductive magnets. This is no easy task, when one considers that superconductivity does not occur until a temperature of 4.6 Kelvin (-269° Celsius) is reached, and this value has to be kept absolutely stable to avoid a sudden reversion to the normally conductive state, which would entail loss of the beam and a long standstill in the experiment. The superconductive components have been developed by DESY in close collaboration with other research institutes and industry, and produced in the required quantities by industry.

#### **Germany: Karlsruhe Research Center Presents Gyrotron**

91MI0344 Bonn WISSENSCHAFT WIRTSCHAFT POLITIK in German 17 Apr 91 p 7

[Text] The Karlsruhe Nuclear Research Center (KfK) exhibited an original gyrotron with dedicated measuring desk at this year's Hannover Industrial Fair to exemplify its large number of technical developments in nuclear fusion technology. Gyrotrons are very high-performance transmitters that heat the plasma in a fusion reactor to ignition temperature by microwave radiation.

The Nuclear Research Center intends its work on nuclear fusion to contribute toward opening up a promising future energy source. It will use the energy released

during the fusion of light atomic nuclei, initially of heavy (deuterium) and superheavy hydrogen (tritium). Research work throughout the world is concentrating on the Tokamak reactor, where the fuel is enclosed contact-free by magnetic fields as completely ionized plasma at a temperature of 100 million degrees. The nuclear fuel tritium is produced from lithium in a blanket surrounding the plasma by means of the neutrons released by the fusion reaction. Thermal energy utilized for power generation is also produced in the blanket. The KfK's work is carried out by a "nuclear fusion development association" set up jointly with the Max Planck Institute of Plasma Physics in Garching in 1982 and is an integral part of the European fusion program.

In the case of the gyrotron presented by the KfK, an electron cavity beam is directed along a homogeneous magnetic field in the electronconductive tube, which is open on one side, i.e., a cavity resonator. The electrons spiral around the magnetic-field lines like the electrons in the fusion plasma.

As the electrons oscillate in time with the electromagnetic wave in the cavity resonator, their energy is transferred to it with particular effect. The electromagnetic wave thus carries a substantial proportion of the electrical output of the electron beam along with it and, upon reaching the open end of the resonator, is oriented, radiated, and transported to the plasma via waveguides.

#### **Germany: Superconducting Cables for Tore Supra Tokamak Produced**

91MI0324 Stuttgart LASER & OPTOELEKTRONIK in German Apr 91 p 10

[Text] For the first time, four superconducting cables, each 150 m long, have been welded into a vacuum-tight special steel casing using a Hoesch laser welding process.

The "Tokamak Tore Supra" experiment is presently under way in Cadarache, France, as part of plasma physics research directed toward a fusion reactor. A superconducting poloidal magnetic system will later be added to this superconducting toroidal magnetic circuit in order to increase the plasma combustion time to 30 seconds without raising electricity consumption. This was the application for which this tie conductor was developed. The final stages of manufacture are described below.

The Karlsruhe Nuclear Research Center (KfK) and Hanau-based Vacuum Melting (VAC) have jointly developed a tie cable consisting of 78 superconducting wires, which will first be used to manufacture an experimental 3-m diameter coil. The 600 meters of conductor required for this purpose were manufactured in 150-m lengths. The coils of up to 8-m diameter that will subsequently be needed for the experiment require conductors 10,000 m long, which will be produced in 400-m lengths.

The requisite superconducting cable strength was ensured by a casing made of four welded special steel

profiles. High production costs and considerable know-how were required both for the high-precision joints for the dimensionally accurate quarter profiles and for the internal conductor. A high-precision welding process with minimum energy dissipation was needed to ensure compliance with exact geometrical requirements and with maximum temperature values.

In a specially designed guide system, two quarter-profiles were welded into a single U-shaped profile. The 1400-W laser output used made it possible to produce approximately 3,000 mm profile per minute. The superconducting cable was subsequently laid in the U-shaped profiles, which were then welded together in a continuous process by two CO<sub>2</sub> lasers working simultaneously. The welding depth of 1.5 mm was maintained with such precision along the whole length that the superconducting cable suffered no damage, nor did the weld section fall short of the dimensions required to maintain the requisite strength.

#### **Italy: Nuclear Physics Institute Builds Particle Accelerator**

91MI0300 Milan *ITALIA OGGI* in Italian

23 Apr 91 p 18

[Text] The construction of the Dafne accelerator has begun in Frascati. The construction work is taking place in the same building that houses Adone, the same kind of accelerator which has been in operation since 1968 and which will be dismantled. A total of 70 billion lire in funding has already been included in the INFN's (National Institute for Nuclear Physics) five-year plan.

Why another particle accelerator? "Because this latest model features a "luminosity" that makes it unique in the world," replied Enzo Iarocci, head of the INFN laboratories in Frascati. Its operating principle, the accumulator rings, is not new. Electrons are accelerated in one ring and positrons, particles with the opposite charge, are accelerated in another. Once the desired energy has been reached, the two beams are made to collide. Their head-on collision, with ensuing destruction, generates a "sun," a new subatomic particle with an extremely short lifespan: the phi meson. The innovation lies in the fact that this gives rise to numerous collisions and hence numerous "suns": 10,000 phi per second. This means approximately 10 billion phi a year. Iarocci explained: "By observing so many events, we can gather the information needed to acquire a better understanding of these rare processes."

The machine, which produces so many phi, is also called a "phi factory," but is also a factory of k mesons, because each phi divides into two extremely low energy k's. This is another characteristic that makes Dafne unique. In fact, when it begins operating - planned for 1995 - low energy k's will permit certain aspects of subnuclear interactions to be examined. Iarocci added: "In particular, it will be possible to study the violation of the charge parity (CP) symmetry, a process discovered in 1960, but still not fully understood. The exceptional

number of events and the particular testing conditions of the new machine should facilitate the development of similar programs."

There is a lot of talk about increasingly high energies in the field of accelerators. The energy generated by the renowned American SSC (supercollider) is 40 trillion times greater than that of Dafne. Since the ultimate goal is to find out about "the building blocks of the universe" and the forces that keep them together, the implications of using such widely differing energies naturally come to mind. As Luciano Mandelli, manager of INFN in Milan, explained: "Both lines of research using either extremely high or low energy are necessary. The tests to be carried out with Dafne involve making extremely accurate and advanced measurements in a known field. Instead, history has shown that working with extremely high energies means discovering something completely new, finding something needed by the theory. Therefore, the major topics in this field are: the discovery of the originating particle of mass (Higgs boson), finding the top quark and verifying that for each existing particle there is another (the supersymmetrical particle) that differs in one single characteristic (the spin)."

Researchers operating in other areas of physics maintain that "particles" are granted most of the government funding in Italy. What is Mandelli's opinion? He replied: "Comparisons should be made between research programs and their real financial needs as well as the ability to make the most of funding. This is certainly the case of high energy researchers, both in view of the excellent Italian school established by Fermi and numerous international contacts."

## **SUPERCONDUCTIVITY**

#### **Germany: Juelich Institute Simulates High-Temperature Superconductivity**

91P60208 Frankfurt/Main *FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT* in German 26 Jun 91 p 8

[Text] At the Juelich high-performance computer center, success was achieved for the first time in numerically detecting high-temperature superconductivity in a special electron-phonon model. In the view of the Juelich Research Center GmbH, this is a significant step forward toward a better theoretical understanding of high-temperature superconductivity. Scientists Ingo Morgenstern, Martin Frick and Wolfgang von der Linden succeeded in simulating superconductivity, using a CRAY Y-MP 832 supercomputer.

The starting point for the simulation was the Hubbard model used by numerous research groups throughout the world. This model describes exclusively the copper oxide levels present in all high-temperature superconductors. Already this model can explain a series of one-time electronic and magnetic properties of high temperature

superconductors in their normal conducting state. Here-tofore, using the Hubbard model, superconductivity itself could still not be understood. Now Morgenstern, Frick and von der Linden have studied a follow-on to this model. Here, in addition, the movement of the charge carriers is linked to the local oscillations of so-called apical oxygen. The apical oxygen are located at the apex of an oxygen pyramid over the surfaces. The significant role of apical oxygen was recognized very early on by Nobel prize winner K.A. Mueller. Up to now, all attempts to numerically detect high-temperature superconductivity could not be clearly interpreted. Now, Juelich has succeeded in doing that.

After this successful simulation, it will now be a question of experimentally substantiating the importance of the model suggested. The goal is to manufacture superconductors which can sustain a current density sufficiently high for technical applications.

According to the Juelich Research Center, up to now, it has not been possible to manufacture superconducting ceramics of such quality as to permit the manufacture of wires for high-current technology. In simulations already underway, those at Juelich want to get on the road [toward solving] this problem.

#### **Laser Ablation Upgrades Thin Film Technology**

91AN0382 Rijswijk POLYTECHNISCH WEEKBLAD  
in Dutch 11 Apr 91 p 1

[Article by Harm Ikink: "Laser Produces Superconducting Thin Films"]

[Text] The future of superconducting thin film production technologies lies in a combination of the currently used sputtering process and a new technique called laser ablation. This is the firm belief of Eng Dave Blank from the University of Twente, who is completing his Ph.D. on this subject later this week.

Blank conducted his research at Prof. Dr. H. Rogalla's Low Temperatures department. During the past three years, this department has joined the select group of the world's leading laboratories in the field of superconductivity. Rogalla and his Twente-based team frequently made the headlines with the development of a sputtering process for the manufacture of thin films of the ceramic superconductor YBaCuO; this occurred for instance last August, when they presented a manufacturing process for Josephson junctions (the building blocks for future superconducting electronics).

In the shadow of the success achieved with the sputtered layers, Dave Blank worked on a completely different deposition process, called laser ablation. His work resulted in a Ph.D. thesis in which he describes how ultrashort excimer laser pulses can be used to produce a plasma of the superconducting material which is then deposited on a substrate.

In a vacuum chamber, the laser beam is focused onto a rotating target of YBaCuO. At a frequency of a few dozen Hertz, a 20-nanosecond laser light pulse is beamed at this rotating target. These few nanoseconds of each pulse suffice to evaporate and ionize the superconducting material. In addition, the plasma is heated to a temperature of more than 10,000 degrees [Celsius]. This energy squirts the plasma toward a substrate set up elsewhere in the vacuum chamber, thus creating a microscopically small crystal which grows slowly until it forms a superconducting thin film.

#### **Asset**

Shortly after the inception of the research, which was financed from a special development fund of the University of Twente, it was clear that the new deposition method was to become a success. The laser was installed in 1988 and high-quality superconducting films were produced from the very outset. The high growth rate obtained with this method soon revealed that it had a major edge over conventional sputtering methods.

It takes several hours to grow an YBaCuO film of only a few micrometers thick using sputtering equipment. With the Twente-developed laser ablation process, a growth experiment takes only a few minutes, an advantage which will yield hard cash in future commercial applications. In addition, the short growing time has advantages for the production of multilayer devices, since it can considerably reduce accidental diffusion between layers with a different composition. More abrupt interfaces can thus be achieved, which is an asset in the production of superconducting electronic devices.

#### **Pellets**

However, enthusiasm about the initial surprising results obtained 2 years ago was somewhat damped by the morphology of the laser ablation layers. The electron microscope showed that small pellets were scattered all over the surface. These microscopically small spheroids made the manufacture of multilayers impossible because they would pierce through the layers and produce short-circuits.

In his thesis, Dave Blank explains how the forming of these inhibitory pellets can be prevented by increasing the diameter of the focused laser beam. Blank is now one step ahead of his international fellow-researchers. They concentrated their research on the laser intensity, without finding a solution. Blank was the very first one to study the spot size of the incident laser beam. He discovered that the spot size had a quadratic impact on the growth rate, in spite of the resulting decrease in light intensity.

Blank could not find any sound explanation for the pellet phenomenon. He assumes that the pellets are produced by drops which, during the violent energy explosion occurring during a laser pulse, are catapulted from the evaporating target toward the substrate. When the laser spot is large enough, these excessive explosions can be



avoided, and the surface created is perfectly smooth. Since less superconductor material is wasted in the form of drops, the growth rate can be considerably increased.

#### Equipment

Now that the optimum parameters for laser ablation have been determined, the Twente researchers are taking on the manufacture of multilayer structures and electronic devices.

Two Ph.D. candidates have already followed in Blank's footsteps. They developed a system which has at least as much potential as the successful sputtering technique.

Other scientists conducting research on superconducting films have also achieved similar results. Blank reports that laser ablation equipment is being procured by both the universities of Amsterdam and Delft.

However, he does not consider laser ablation to be a direct competitor for sputtering techniques. In specific cases, the perfection of sputtering techniques will be required, whereas in other cases, a faster laser deposition will be preferable. So Blank thinks that equipment combining both processes will stand the best chances in the future.

## TELECOMMUNICATIONS

### European PTT's Preparing for Single Market

91AN0482 Amsterdam *COMPUTERWORLD* in Dutch  
12 Jun 91 p 19

[Article by Elizabeth Horwitt of IDG: "European PTT's Are Gearing Up for the Battle in the Network Market"]

[Text] Recently the European PTT's [national operators of post, telegraph, and telephone services] have been paying far more attention to their international customers than previously, because when borders in Europe vanish shortly they want to be able to play a key role.

The market for trans-European network services is growing fast.

Companies are increasing their presence in Europe and introducing new systems and networks to handle such activities as distributed stock management and sales analysis.

Some companies find it unnecessary to install full-blown information systems in each of their European offices. They therefore want to set up telecommunication links between those offices and the data center in their headquarters.

Credit Suisse, for instance, already had a highly centralized structure with a staff of 1,200 data processing people working at its Zurich headquarters. This financial

institution is considering further cutbacks in its international technology centers, according to Oscar Gemsch, senior manager for information systems (IS) with Credit Suisse.

"At least three large concerns that I know of have concentrated their European IS activities in one data center," says Thomas Koehler, head of Andersen Consulting's services group in Germany.

#### Lowering Tariffs

After a long and untroubled existence thanks to their domestic monopoly positions, the European PTT's are now aware that they will have to compete with each other in order to protect their share of the growing multinational network market.

U.S. companies tend to single out one or two countries as communication centers for all their European branches. They often give preference to the PTT company which offers the best combination of services and tariffs. Here PTT's which show little enthusiasm for lowering international tariffs, such as the Deutsche Bundespost, compare badly with organizations like British Telecom and the French PTT, which are more responsive to demands of American users with regard to the tariff structure.

According to spokesman Lorenz Moosmuller, the Deutsche Bundespost is well aware that lower tariffs are necessary, but its price setting capacity is hampered by its liability to provide financial support for the improvement of the telecommunications infrastructure in the former GDR.

Both in the United States and in Europe, multinational organizations are increasingly inclined to call in value-added network (VAN) companies with worldwide operations to put together their international networks. For many multinationals, it is sensible to contract one company to handle all contacts with the different foreign PTT's and to track down the origin of any problems.

PTT's have reacted to this by setting up their own value-added networks and by making agreements for one-stop-shopping with large American international telecommunications organizations and VAN suppliers.

The latest aggressive changes have been introduced by the Belgian Regie des Telegraphes et Telephones (RTT). The recent RTT initiatives include:

- A new law under which the RTT becomes a *public autonomous company* with more control over its own budget and competition policy. In this way, the RTT will have the flexibility required to compete more effectively with private concerns in the European telecommunications market. At the beginning of the this year, the French Government introduced a law which attempts to bring about the same situation for the French PTT;
- A bilateral agreement with AT&T in September of last year for the delivery of worldwide Software



Defined Network Services, International Telephone and Telegraph Consultative Committee (CCITT) X.400 interconnections for electronic mail services, and one-stop shopping;

- A similar agreement was signed in March with U.S. Spring;
- A second international gateway to provide customers with redundant backup connections;
- An investment in a fiber-optic cable to connect Great Britain with the rest of Europe via Belgium.

### Fierce Competition

Several less advanced PTT's have started marketing campaigns this summer to show how energetically they are working on the restyling of their networks. Earlier this year, for instance, the Swiss announced that over the next four years they will be investing more than \$10 billion in the digitization of more than 90 percent of their exchanges and in the installation of a complete integrated services digital network (ISDN) in 1992.

During the official opening of its first American office, Telefonica, the Spanish public operator, presented itself as the "natural pivotal point of the world." By the end of next year, the Spanish PTT intends to have 82 percent of its trunk lines and 56 percent of its local lines digitized. ISDN will also be introduced and by July, 56 Kbit/sec and 64 Kbit/sec switching circuits will be generally available. The French PTT, which still is in a monopoly position, is in the lead when it comes to the use of advanced network services such as ISDN.

At the beginning of this year, new regulations went into effect giving VAN suppliers easier access to the French market to offer their communications services. In addition, the ties at the economic and managerial levels between the French PTT and the government were cut. Now, the French PTT has its hands free to use all its profits for the improvement of services and the setting up of new initiatives.

### European Industries Take Lead in Optical Fiber Technology

91WS0365A Duesseldorf VDI NACHRICHTEN  
in German 10 May 91 p 24

[Article: "Europeans Are World Champions of Fiberoptic Technology"; first paragraph is VDI introduction]

[Text] The optical waveguide industry in Europe is headed for success. The European fiberoptics market occupies first place worldwide, even ahead of Japan and the United States. Associated projects all the way to the subscriber's building and the new SDH [Synchronous Digital Hierarchy] standard are setting the trend.

When Gerd Tenzer, a member of the board of directors of DBP Telekom, speaks of the opportunities of

fiberoptic technology he is not timid with his visions: "Optical communications transmission with waveguides will lead to a universal, integrated communications network, in which all forms of communication can be realized up to the highest bit rates." The fiberoptics strategist adds confidently: "We are emphatically implementing the introduction of connecting fiberoptic systems."

Tenzer could be a representative of the European telecommunications industry. After all, the Europeans have brought optical fibers, the transmission medium for wideband services by the information society, to a world championship position. With a turnover volume of about 1.1 billion dollars, the European market ranked first in cables and components for waveguide components in 1990, ahead of the United States and Japan, and the success story continues: Deepak Swamy, an analyst with the U.S. market research company Kessler Marketing Intelligence (KMI) in Newport, Rhode Island, predicts that the European fiberoptics market will grow to 2.3 billion dollars by 1995. An average annual growth of 17 percent, right across all of Europe, is what the expert promised in his presentation of the study "European Market for Fiberoptics," released by the U.S. market researchers in mid-March in Newport.

Thus, in the five years under consideration alone, the markets in eastern Europe would grow from the present 7 million dollars to more than 300 million dollars. Altogether, last year the European postal administrations and other network operators laid more than 1.9 million kilometers of fiberoptics cable for public and private networks, three times more than in 1987.

"The markets in the individual countries are growing at varying rates, depending on the regulatory framework conditions as well as the key political and economic factors," Swamy further explains. For example, due to the strategy of France Tom the French market has acquired one of the most modern fiberoptic telecommunications networks in the world. On the other hand, the Spaniards fell behind last year, the reason being the increasing tendency to economize of the private telephone association Telefonica. It was possible to record a continuing high investment trend in fiberoptics projects in Italy, however. Because of the fundamental expansion of the public telecommunications network, including an underwater cable project with which cities on the west coast of the boot were connected, last year the Italians, with a 48 percent growth in turnover, were the second most industrious layers of optical cable after the British.

All told, the five leading European nations of Germany, Great Britain, France, Italy and Spain accounted for 82 percent of the European market in 1990. "But the market share of these countries will decrease," Swamy predicts. The market researcher sees the reason as being the strong demand for waveguide technology in the Scandinavian and eastern European countries.

The German market for fiberoptic technology last year reached a volume of about 289 million dollars. Says analyst Swamy: "The lion's share of 89 percent of the investments in fiberoptic systems was taken up by the communications network expansion, 10 percent of the spending went for public and private data networks and one percent for other projects." Spending on the total of 310,000 kilometers of fiberoptics cable accounted for 229 million dollars, transmission technology and amplifiers for 52 million dollars and cable connections for 8 million dollars. By 1995 the KMI market researchers expect that the German fiberoptics market will grow to a total of 575 million dollars.

The American market observers have discerned two growth trends for Europe: Fiber to the home, meaning projects for connecting up to the subscriber's building, and growing interest in the SDH standard, for linkage of the various network concepts of the individual countries. Philips made a beginning last year with the construction of a digital fiberoptics route in Valencia in Spain, and France Tom as well is in the process of bringing its telecommunications network up to SDH standard.

A spirit of technical invention always distinguishes the European developers, according to the market study. "The Europeans," acknowledges Swamy the American, "are no longer just passive followers of U.S. and Japanese industrial standards." According to him, in many areas they have even taken the technical lead. The British, for example, are far ahead of the others in developing so-called passive optical networks for the cost-intensive subscriber connection field. In Germany the experts at KMI point out Telekom's wideband fiberoptics network as being "one of the best in the world."

There is, however, also an increase in the sale of twisted copper pair lines from insulated telephone cable, mainly used in transmitting telephone conversations. Their sales in Europe will grow from 558 million dollars last year to 702 million dollars by 1995, as indicated in the report "The European Market for Cable & wiring Products for Networks" by the British market research company Frost & Sullivan in London. However, the Europeans who are used to success will have to come down to earth again in their market for coaxial cable—two-core cable with an insulated internal conductor and a mantle with an external conductor. The London experts anticipate a drop in sales from 51 million dollars in 1990 to 43 million dollars by 1995.

There is danger lurking for the European fiberoptics and copper cable market in the competition for wireless extensions. "Although this byproduct for mobile cellular telephones is still in its infancy," the market researchers at Frost & Sullivan warn, "with the drop in price it could be of considerable interest to many customers."

### EC To Launch RACE II Program

91AN0420 Amsterdam *COMPUTABLE* in Dutch  
10 May 91 p 17

[Article by Nigel Tutt: "Provisional EC Agreement Over RACE II Program—Suggested Boycott of 'Non-European' Companies Unsuccessful"]

[Text] Brussels—Ministers from the EC member states have reached a unanimous agreement over future development of the RACE II program, for which an amount of 484 million European currency units [ECU] (about 1.1 billion guilders) has been allocated. A proposal that companies which are not 100-percent European-owned should be excluded was not successful.

RACE II is the second phase of RACE (Research and Development in Advanced Communications for Europe), the technology program which was set up three years ago. Although the agreement has not yet received official approval, there is little chance that the opinions of the various EC governments will change, seeing that their ministers have reached a unanimous understanding.

The RACE program has to lead to the introduction of an integrated broadband communications (IBC) network in Europe by 1995. While under RACE I particular emphasis was laid on strategies for development and implementation of IBC systems, services, and applications, RACE II is to investigate how far integration, standardization concepts, and functional specifications can be achieved. This will involve, among other things, the setting up of advanced communications experiments.

It was also agreed that RACE II would run until December 1994 and would be managed by a committee consisting of national experts under the supervision of the EC Commission. An interim evaluation is planned for the second year of RACE II.

Unanimous accord was reached by the ministers after F. Pandolfi, EC Commissioner responsible for R&D, had forced a discussion of RACE II by putting it on the agenda of a gathering of EC agriculture ministers. In addition, Pandolfi also included in the discussion the three amendments which resulted from the first reading in the European Parliament. The agreement, however, left out the amendments put forward by the EC Commission and the European Parliament. These proposed a stricter definition of which "European" companies could participate in the RACE program.

France, Germany, and the Netherlands had supported a proposal to exclude companies whose headquarters are based in countries which do not accept EC countries in their research programs. This proposal was directed particularly toward Japan and was inspired by the takeover of the British computer concern ICL by Fujitsu of Japan. The three governments were not able to push this amendment through.

The RACE II communications technology program is built around eight project strategies. The first of these is a follow-up of work conducted under RACE I and concerns the changeover to broadband services of 2 megabits per second or more and the leasing of fiber-optic cables from private operators. ECU111 million has been put aside for this.

The second area of research (ECU43 million) involves the techniques which are necessary for the development of intelligent networks, such as "virtual private networks." These are worldwide corporate networks with advanced facilities which use public telecommunications networks but which are operated as private networks.

The third project line concentrates on mobile communications (ECU53 million). The aim is to integrate the various mobile communications services within one infrastructure in order to ensure a wide range of available services.

ECU68 million has been allocated to image transmission. Research in this field should eventually lead to the conclusion that image transmission via an IBC network will be no more expensive than speech communication.

A fifth research area (with ECU39 million) will draw up a set of specifications and standards to which new services must adhere and will investigate how these can be integrated. ECU29 million has been earmarked for research into security of information. This will involve projects on standardization, verification, and certification procedures.

The greater part of the budget, ECU121 million, is to be spent on advanced communications experiments. These experiments will be test cases to demonstrate how potential users react to broadband services. The remainder of the budget, ECU20 million, is for research into infrastructures and the linking together of various national pilot projects.

#### **International Suppliers Join To Provide Private Networks**

91AN0481 Amsterdam *COMPUTERWORLD* in Dutch  
12 Jun 91 p 19

[Text] Four telecommunications services companies are to join forces in supplying private networks to multinationals. They are the American AT&T, British Telecom, France Telecom, and the Japanese Kokusai Denshin Denwa (KDD).

The four have already agreement over standards and procedures. With the agreement they hope to be able to offer a one-stop-shopping service to companies needing international networks.

Up till now multinationals have had to deal with the local telecommunications supplier of each country. This is a time-consuming and laborious chore.

Under the name Joint Network Initiatives, the four companies are to provide coordinated billing facilities, network testing and a common contact point. They will jointly offer services, network hardware (including telephone exchanges) project management, network design, installation of equipment, and network administration.

#### **First Customer**

The first customer will be the Japanese shipping company Nippon Express. Its network covers Japan, Europe, and the United States. Speech, fax, telex, and data are transmitted along the network and in Japan alone it interconnects some 13,000 telephone terminals.

According to Nippon Express, it pays out \$219,000 every month in international telephone charges from Japan. The concern hopes that with the new service it can save \$102,000 per month. The investment will amount to approximately \$4 million.

#### **Key Provisions of EC HDTV Directive Aired**

91P60189 Frankfurt/Main *FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT*  
in German 7 Jun 91 p 8

[Text] After hard-fought internal discussions, EC commissioner Filippo Maria Pandolfi has drawn up a memorandum of understanding with regard to the new television standard to which those concerned, i.e., the EC itself, industry, satellite contractors and European broadcasting organizations, have agreed.

The 1986 commission directive, currently still in force, expires at the end of this year. It stipulated that all television satellites for direct reception must use the D2-MAC modulation system. However, that actually involves only the powerful satellites TV Sat, TDF and Marco Polo.

The following key provisions were established for the new directive: HD-MAC will be the sole European transmission standard for high definition-television (HDTV). Fully digital HDTV will not be available for another ten to fifteen years. The image format is definitively established as 16 x 9 (width x height). A decision is needed with regard to further use of the PAL [Phase Alternation Line] television standard in satellite television. All participants will work together closely in consortia within their countries. Over the next five years, the commission is offering subsidies, in the amount of half a billion ECU's, for program production in the 16 x 9 format and for new satellite channels.

With that, the EC commission has worked out the basis for its directive. According to Peter Groenenboom, senior managing director of Philips, the [directive] could, in principle, appear as follows:

- Television: As of 1 January 1992, all new satellite programming services must operate employing the D2-MAC standard. From this time forward, new satellites must also use D2-HAC exclusively. Existing PAL programming via satellite ends on 1 January 1994; 1 January 1996 for the UK.



- Cable: D2-MAC programming via cable must reach subscribers directly without conversion to PAL or SECAM. All cable [links] are to be expanded to 450 megahertz (MHz)
- Industry: As of 1 January 1993, all satellite tuners offered must be D2-MAC-capable. As of 1 January 1994, all television sets with 56-centimeter screens or larger must have permanently installed D2-MAC receivers.

This EC directive is to remain in force for ten years. However, it is noted that the lapse of PAL telecasts on 1 January 1994 or 1996 is not an automatic occurrence but rather upon the basis of a further separate arrangement, or via the "market mechanism" (whatever that might be). Observers in Brussels, though, believe that this overly soft formulation may provoke internal conflicts between satellite contractors and D2-MAC proponents.

In any case, a new [development] is the approval of Eurocrypt as the sole European encoding technique for pay television, which should put an end to the current furor amongst at least five different encoding methods. France Telecom, Philips, Nokia, and Thomson founded TV Eurocrypt Ltd. for this technique.

#### **Philips, Thomson Prepare HDTV Follow-Up Project**

91AN0432 Paris *ELECTRONIQUE INTERNATIONALE* HEBDO in French 16 May 91 p 10

[Article signed E.F.: "HDTV: The Post-EUREKA 95 Era Being Prepared"]

[Text] With the completion of the second phase of the EUREKA 95 high-definition television (HDTV) project scheduled for the end of 1992, the European manufacturers, in particular Thomson and Philips, are already preparing a follow-up program. Essentially, two complementary projects will derive from the basic research conducted in the framework of the EUREKA 95 project: One on flat liquid crystal displays and the other on high-definition video recorders for the general public. In both cases, the major part of the research will be conducted by the German branches of the two European concerns. Thus, public funding would have to be provided mainly by the German Government. Here, the first difficulties crop up: If Thomson and Philips like to start new projects before the end of 1991, Germany, which has modified its subsidizing scheme to respond to the needs of the five new federal states of the former GDR, will not be able to plan new aid until after 1992. However, M. Kreuzer, chief of the division concerned at the German Ministry of Research and Technology, still urges the manufacturers to elaborate their ideas in greater detail. "We will meet our commitments in EUREKA 95. For the post-1992 period, no concrete proposals have been made yet," he specified.

Thomson and Philips estimate that they will need a total of some 20 billion French francs [Fr] in funding over a

five-year period (mid-1990 to 1995) to complete their HDTV research. Thomson, which will have to contribute Fr9 billion, signed a framework contract with the French State: Out of the Fr9 billion, Fr6 billion will be spent in France (including Fr3 billion in subsidies); the remaining Fr3 billion will be used in foreign research projects.

#### **Philips HDTV Equipment To Be Ready by 1994**

91AN0478 Paris *ELECTRONIQUE INTERNATIONALE* HEBDO in French 13 Jun 91 p 12

[Article signed E.F.: "Philips Will Launch Its High-Definition Television Sets in 1994"]

[Text] The Dutch group is proving its firm and definitive commitment to the HD-MAC high-definition television (HDTV) standard.

Philips has hit the ball into the court of its integrated circuit department. As the latter is to produce a sufficiently miniaturized HD-MAC decoder earlier than expected, Philips Consumer Electronics is already considering bringing forward the launch date of its HD-MAC receivers to 1994. The Dutch group is thus clearly demonstrating its commitment at a time when the European Commission in Brussels is in the middle of bringing out a directive making HD-MAC the sole standard for HDTV. Philips has also announced the introduction, expected next August during the Berlin international sound and video exhibition, of its 625-line receiver in 16/9 format fitted with a D2-MAC decoder. Thomson Consumer Electronics played the role of pioneer in this field a few months ago.

Despite the prohibitive cost of such a receiver, on the order of 30,000 French francs [Fr], the two manufacturers are now counting on the size of the image to attract TV viewers keen on new techniques. EC Commissioner Filippo Maria Pandolfi hopes to achieve a first reading of the directive during the July session of the European Parliament. If this directive is adopted, it will be valid for 10 years and will favor HD-MAC as the sole standard for HDTV. It sees D2-MAC in 16/9 format as an obligatory intermediate stage for all new satellite TV services. The existing services will be able to continue to broadcast in PAL [Phase Alternation Line], but they will be encouraged to broadcast a D2-MAC version as well, mainly through direct financial aid. On this latter point, Brussels has put forward a figure of around 100 million European currency units [ECU] per year over five years. For the moment, no time limits have been set for broadcasts in PAL.

It should be noted that the official date for the introduction of HD-MAC receivers onto the market had initially been set for 1995. However, some 1,000 prototype 1,250-line TV sets in 16/9 format will already be available for the Olympic Games in Barcelona in 1992. These will be fitted with so-called second-generation decoders as currently produced by Philips.



### Rapid French Videotex System Expansion Reported

91AN0489 Paris LA LETTRE DE TELETEL (special issue No 7) in French May 91 pp 3, 5-6

[Article: "1990 TELETEL Facts and Figures"]

[Text]

#### Minitel Terminals

In 1990, 545,000 Minitels were installed by France Telecom, bringing the number of Minitel terminals to

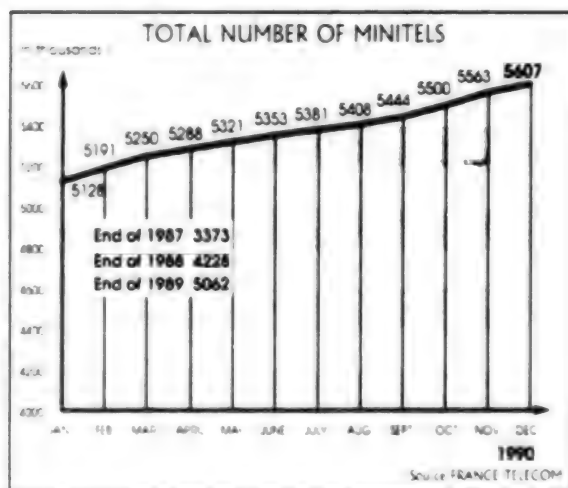
5,607,000, including 978,400 terminals on rental-maintenance service with a subscription supplement.

On 31 December 1990, 20 percent of all telephone subscribers were equipped with a Minitel.

This level of market penetration means makes it possible for 29 percent of the population to have access to a Minitel terminal. This means 41 percent of the work force has Minitel access.

SEREHO Survey for France Telecom, December 1990

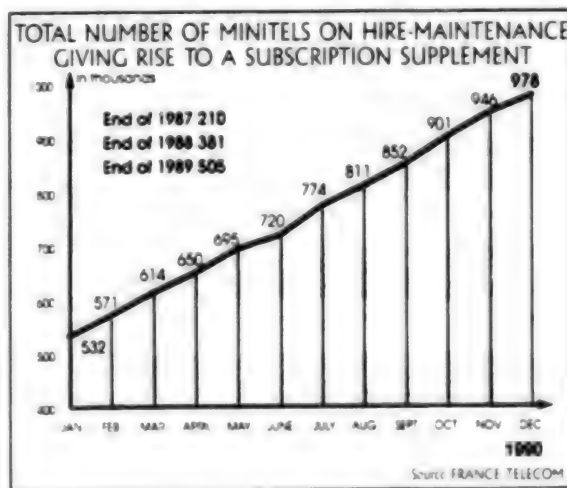
	Percentage of the total population over the age of 15 having access to a Minitel	Percentage of the work force having access to a Minitel
Access at home	20	24
Access at work	16	30
At least one of the two (at home or at work)	29	41



The year 1990 was marked by the celebrating in February of the 5 millionth Minitel installed and by the marketing of the flat-screen portable Minitel 5 which can be used in public sites with the aid of an acoustic accessory device or from a radio telephone.

The number of Minitel 12s and Minitel 2s sold in 1989 increased at a normal rate. In December 1990, the number installed was 200,000 Minitel 12s (vs 95,000 by the end of 1989) and 415,000 Minitel 2s (vs 13,000 by the end of 1989). The number of Minitels on rental-maintenance service with a subscription supplement almost doubled in 1990.

Two significant applications using LECAM, the smart card reader, were implemented in 1990. France's National Railway Service (SNCF) offered a smart card electronic booking service for the reservation and payment of a train ticket and the Banque de France a service



for updating the national file for stolen checks. LECAM provides the security required for this type of consultation.

#### The TELETEL Access Service

The TELETEL access network consists of the telephone network, Videotex Access Points (PAVI), and the TRANSPAC packet switching data network and provides connection between the terminals and host computers.

This network is constantly developing, both quantitatively and qualitatively, to keep pace with the developments in traffic and the increasingly sophisticated needs of users.

#### Access Capacity of the TELETEL Network

The number of ports available on PAVI is an approximate indicator of the potential number of simultaneous calls that can be handled by the TELETEL network.

### Growth in Number of Access Ports of the TELETEL Access Service (SAT)

Dec 1987 .....	43,160
Dec 1988 .....	49,611
Dec 1989 .....	50,500
Dec 1990 .....	61,000

Thanks to the 1989 PAVI software version, two new services were marketed by the TELETEL network in 1990, namely the routing and rerouting services. The routing service increases the possibility of optimizing access to the TELETEL service with regard to the distribution of costs and protection of access to a monosite or multisite host computer.

Rerouting is the TELETEL network function which allows a host computer to communicate with another host computer without intervention by the user. While communicating with a user, the host computer can ask the Access Point to connect the user to another host computer so that the user can use the additional services offered by the other host computer. At the end of 1990, 170 "rerouting" codes were recorded on the TELETEL access service.

### TELETEL International Network

The growth of international videotex traffic is linked to the interconnections of the TELETEL network with other foreign videotex networks via Minitelnet, the international gateway operated by Intelmatique SA.

Thus, the users of a foreign national videotex network are able to gain access to the French TELETEL service and, similarly, Minitelnet allows French users of Minitel to gain access to videotex services outside France.

In 1990, the most important factor was the extension of access to the TELETEL network from abroad thanks to the interconnections set up with Italy in February; Germany and Luxembourg in March; Portugal in May; and Denmark in December.

The international traffic has quadrupled in 1990, from 30,000 hours in 1989 to 146,200 in 1990. Of this traffic, 20 percent is from Belgium and 54 percent from Italy, the country with the most dynamic policy for the growth of videotex. Unlike most of the other European networks which mainly aim at companies, the Italian SIP has expanded its videotex service to the general public and adopted TELETEL as the standard for the videotex system.



With regard to accessible services abroad, the Electronic Directory is the most frequently consulted: 40 percent of the traffic is from Belgium; 9 percent from Luxembourg; 8 percent jointly from the United States and Canada; and 5 percent from Italy.

The professional services available through kiosk access (3617, 3628, and 3629) are increasing rapidly.

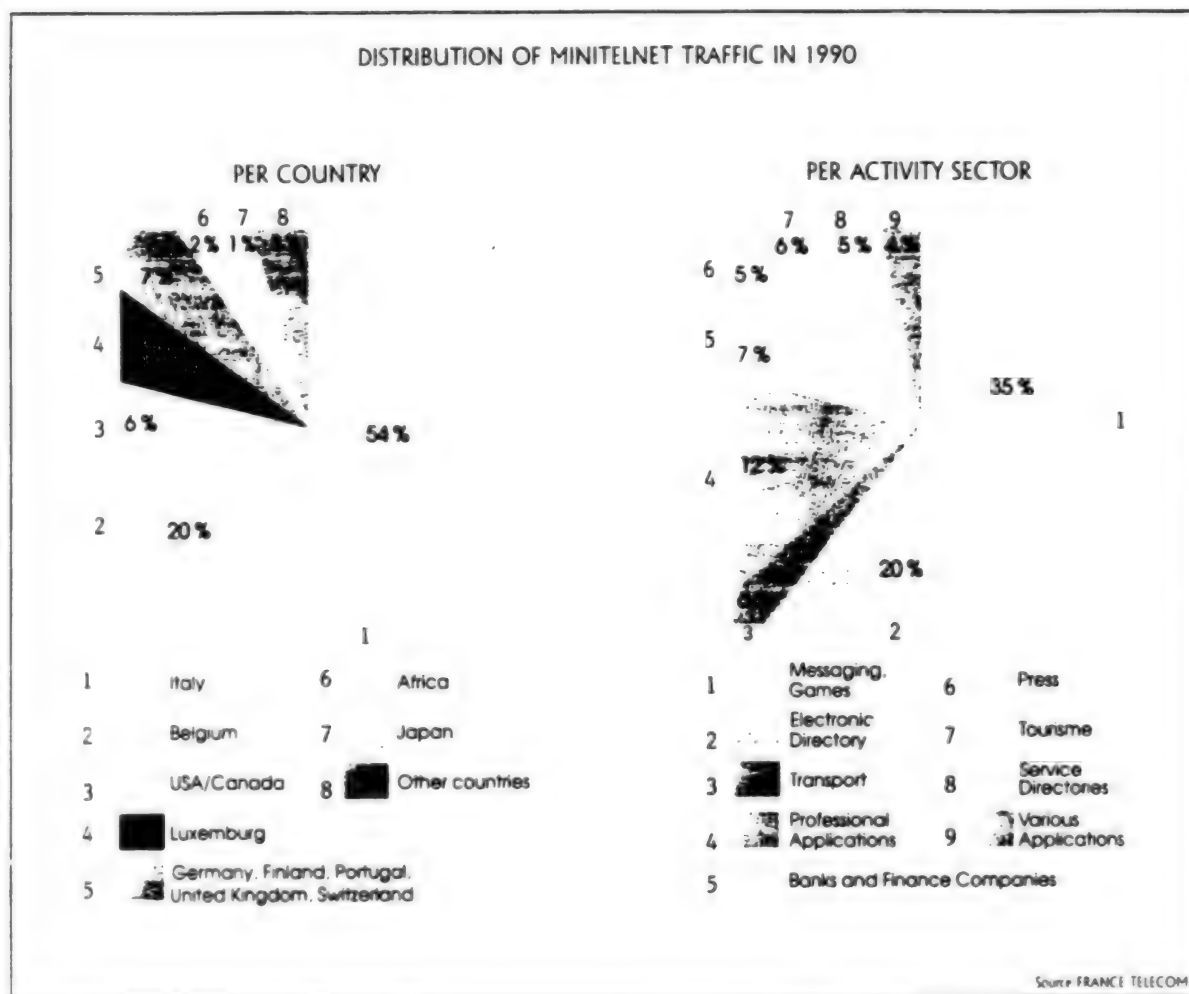
Using Minitelnet, TELETEL services are currently accessible from the following countries:

- by the country's national videotex network through interconnected networks or through an agreement with the country's telecommunications administration: Germany, Belgium, Ivory Coast, Denmark, Djibouti, Egypt, United States, Finland, Italy, Luxembourg, Madagascar, Niger, Portugal, Chad, Togo, Senegal;
- by Minitelnet subscriber distributors: Spain, Korea, Japan, UK, Switzerland, Singapore;
- by individual subscribers to Minitelnet: Australia, Austria, Ireland, Norway, Netherlands, Sweden.

... and all countries with an X.25 network connected to the International Transit Node.

In June 1990, a partnership bringing together Eireann Telecom (the Irish Telecom); the Allied Irish Bank, one of the two Irish leading banks; the Credit Lyonnais; and Intelmatique SA was set up in Dublin to create the Minitel Communication Ltd Company.

The setting up of this company was aimed at a general public videotex market in Ireland by applying the TELETEL concept within the country's framework.



### France Telecom Claims Lead in ISDN Standardization

91WS0421A Paris *MESSAGES DES PTT* in French May-Jun 91 p 17

[Article: "International Standardization Efforts: A Network Without Borders"]

[Text] By 1989, France had ensured its network compatibility with foreign countries. Besides, Germany, Great Britain, Belgium, the United States, and Japan have hooked up to the Numeris network, improving global communications.

Numeris is universal. It was designed to be universal. Today, our national network is linked to Germany, Belgium, the United States, Finland, Japan, the Netherlands, the United Kingdom, and Singapore. But even before digital lines were set into service, France Telecom had initiated a standardization process with foreign countries.

Their goal was to ensure that all subscribers could communicate with one another, irrespective of which country they were calling from.

It all started at the CCITT (International Consultative Committee on Telephony and Telegraphy), the body responsible for international telecommunications standardization. "In 1984," said Michel Boussarie, in charge of the international ISDN product at the marketing and development department of the Foreign Networks Directorate, "the CCITT published a red book. It contained the first set of ISDN [integrated-services digital network] recommendations that was published." These guidelines enabled many countries to prepare for the implementation of ISDN on their territories. One of them, France, took the lead by marketing the Numeris network already in December 1987. "The other major industrialized countries," Michel Boussarie went on, "started their networks only in 1988-1989. In the meantime, the CCITT had published a blue book: it dealt with the ability of the various ISDN's to communicate with one another, and with the interchangeability of the terminals used in various countries."

The interconnection of the ISDN's therefore started in 1990. Two versions of the signalling system are used to set up and end calls. Both versions are implemented in France Telecom's international exchanges. This makes it possible to open ISDN connections from France to most industrialized countries. That is not true of all countries. Some countries have developed only one version. Since the two versions are not compatible "on line," France Telecom offers to act as a relay between any two countries using different versions. Thus, communications between Germany and Japan go through France Telecom's international exchanges.

In Europe, a draft agreement was signed in April 1989. Referred to as MoU (Memorandum of Understanding), it provides that the signatories—20 European countries representing 26 operators—will implement compatible ISDN's by 1993, offering users identical services.

One condition remains to be fulfilled: terminal compatibility, as recommended in the CCITT blue book: "The best example is the group-IV facsimile machines, built according to international standards," explained Jean-Pierre Bienaime, assistant marketing and development manager at the Foreign Networks Directorate. "We try to develop applications that will meet the needs of our international clients. They deal with facsimile transmission, but also with file transfer between PC's, videoconferencing, audioconferencing, high-quality sound, etc. With these applications, we meet most of the demand. Of course, more sophisticated applications are already operational at international level. The Index company uses the ISDN between Germany and France for the maintenance of its machine-tools. French and Japanese hospitals exchange scanner images through the ISDN; nuclear medicine specialists can exchange their diagnostics without any waste of time for the patient..."

The development of international applications and the extension of Numeris interconnections with other countries therefore remain France Telecom's priorities. Scheduled for the next few months: Italy, Spain, the Scandinavian countries, Hong Kong, and Australia...

### **French Firm Develops Cellular Telephone Strategy**

91WS0421B Paris MESSAGES DES PTT in French  
May-Jun 91 pp 30-32

[Article by Adle Vincent: "A Subsidiary of the General Water Company, SFR [French Radiotelephone Company], in the Major League"; first paragraph is MESSAGES DES PTT introduction]

[Text] Selected, together with France Telecom, to market a new European digital cellular telephone system, SFR has joined the very exclusive club of major European operators. Three years after its creation.

The SFR is just as discreet as its parent company, the powerful General Water Company. Discreet, but efficient: since its creation in February 1988, SFR has managed to

implement in record time the second national cellular telephone network, competing with France Telecom's Radiocom 2000. Fortified by the authorization just received from Paul Quiles, it now also launches itself into the battle for the European cellular telephone system, the GSM [Groupe Speciale Mobile].

That was truly a race: Between the minister's authorization, in December 1987, and the installation of the first radio relay, in November 1988, the few tens of people employed by SFR did not have much respite. They had to win what amounted to a bet, and to show that competition is possible in the cellular telephone sector, a sector still in its infancy.

The first stage was the financial one: Estimates showed that the installation of the second cellular telephone system would gobble up close to 400 million French francs [Fr] per year during the four or five years required for its implementation. As a result, the General Water Company found six French partners (including Credit Lyonnais and TDF) and six foreign shareholders to form the Radiotelephone Financial Company [COFIRA], and later on SFR, a wholly-owned COFIRA subsidiary in charge of operating the system.

The second stage was the industrial one. In April 1988, SFR entrusted to Alcatel Radiotelephone the manufacturing and installation of the equipment (exchanges and base stations) needed to operate the network. Finally, there was the commercial stage: rates and contracts were carefully studied, and the network was inaugurated in the Paris area on 30 March 1989.

Since then, the baby has grown a lot. SFR can now boast to have over 65,000 subscribers. Promising beginnings. Better still, the General Water Company has also achieved a few nice feats in Europe. At the beginning of the year, it quietly acquired a majority interest in one of the largest British cellular telephone marketing companies, Talkland, which had sales of Fr1.3 billion and 165,000 subscribers. It wanted to operate in Germany, but had to yield to Manesmann. But it has certainly not said its last word in Spain and Portugal.

The SFR, however, still faces a major battle. With the new authorization it was granted last March, it joined a very exclusive club: that of the major European operators selected to install the digital cellular telephone of the future, the famous GSM. "When it allocated a 12.5-MHz frequency band to each of the two operators, the Directorate of General Regulations created the conditions required for an ambitious development of public cellular telephony in France," according to Paul-Louis Girardot, chief executive officer of COFIRA. "Competition between the two operators was organized in a very well balanced, very sound, and highly visible manner."

### **European Implementation**

With the GSM, cellular telephony will at last be able to take off. The frequency restrictions that currently make it impossible to serve more than 500,000 subscribers on



French territory will be a thing of the past. Thanks to digital technology, the 25 MHz allocated to the two operators will enable them to serve some 4 million subscribers on mainland France. But before that, SFR, like its competitor, France Telecom, will have to invest heavily: Fr3 billion until 1996, according to COFIRA estimates.

And the race against the clock will start anew to meet the scheduled deadlines and start the GSM commercial service by mid-1992. As far as the network substructures are concerned, SFR has already decided: Alcatel will be its main supplier, followed by GEC [General Electric Company] Plessey Telecom. These two companies are already working on the implementation of the first two networks, including some 100 base transmitters, to be set into service in Paris and Lyons in 1992. Installation of the Lille-Marseille-Nice line will come next.

The network as a whole, with its expected 1,000 cells, should be completed by 1995 or 1996. As for the terminals, the General Water Company's subsidiary is planning to order a first series of 10,000, mostly European-made, in the next few months. It enjoys a considerable advantage in this respect: being represented throughout Europe, it will be able to order large quantities of these terminals, which can be used in all European countries that have adopted the GSM system.

Between the analog system, which is available today, and the digital system that will replace it, the outlook for SFR is promising: 150,000 subscribers by 1992 (including a few thousands GSM subscribers), 500,000 in 1996, 1.5 million to 2 million by 2000. Its sales, too, should take off rapidly and reach Fr1.5 billion to Fr2 billion in four years from now. After years of heavy investments, the General Water Company's subsidiary will then, at last, harvest the fruits of years of efforts. And perhaps launch itself into a new battle...

[Caption, box p 32]

**Areas Covered by the SFR Cellular Telephone Network, as of January 1991**

Dark orange: Receiving areas - March 1991

Medium orange: Receiving areas - September 1991

Light orange: Development under consideration

**France Telecom Subsidiary To Market Videotex Internationally**

91WS0421C Paris *MESSAGES DES PTT in French*  
May-Jun 91 pp 33-34

[Interview with Luc Guillet, Intelmatique Chief Executive Officer, by Christian Sotty; "The Minitel's Global Ambitions"; first paragraph is *MESSAGES DES PTT* introduction]

[Text] And now for America! After France, after Europe, the Minitel is about to storm another continent. Its

spearhead: Intelmatique SA, a France Telecom subsidiary. Its chief executive officer, Luc Guillet, unveils his strategy for *MESSAGES*.

**MESSAGES DES PTT:** At the end of 1992, European borders will fall. Is the French Minitel getting on its marks?

**Guillet:** It is leading the pack! Of the 6.5 million users of the European videotex, 5,607,000 are in France. To strengthen its position, France Telecom multiplies interconnections between networks. The international traffic is developing at a fast pace. From around 30,000 hours in 1989, to probably over 250,000 hours in 1991. Ireland, Switzerland, and Spain will join the network this year. Next year, European countries not connected to Teletel will be a rarity. And where Videotex is not yet available, we implement it. We have already done so in Ireland and we shall probably soon have to do the same in other European countries.

**MESSAGES DES PTT:** Therefore, the Minitel does not have any serious competitor in Europe?

**Guillet:** Take Italy. After starting with the British Prestel standard, it is implementing a system that is nearly identical to the French Teletel. The reversal is all the more significant as the Italians really want to get involved in videotex. Their objective is to have 2 million users by 1994. If they succeed, in three years from now, they will have the second videotex network in the world. After France.

Besides, the three main European systems (Teletel, Prestel, and BTX [German videotex system]) can be interconnected, and you can always use multistandard terminals. But I don't believe that there will be a war about standards. The market will choose one—it may already have done so. Thus, the day the Italians chose the Teletel standard, servers started to multiply. To such an extent that Teletel now accounts for 80 percent of all Italian servers. This boom seems to indicate that eventually, in Italy, practically all services will use Teletel.

**MESSAGES DES PTT:** The conquest of America seems less obvious...

**Guillet:** It is our priority, with Europe. It is unthinkable to overlook the United States while developing videotex.

**MESSAGES DES PTT:** But how are you going to take over the American fortress?

**Guillet:** Our strategy is partnerships. That's the only way to approach such a large market. Therefore, we are looking on location for sizeable partners, in part among regional telephone companies, as videotex is an extension of telephone services. But a partnership does not solve all problems. We are dealing with very subtle regulations. Any American partner we may have will have little room to maneuver. It will not be allowed to build a national network. It will also be prohibited from offering information services worthy of the name. For instance, a U.S. regional telecommunications operator cannot offer the equivalent of our electronic directory. It will be allowed to

set up only a very rudimentary service. Therefore, we will not be able to use the electronic directory to launch the Minitel, as was done in France. In spite of these difficulties, we are now negotiating with an American partner. We even hope to reach an agreement very soon.

#### [Box, p 33]

#### Videotex Interlinks

What is videotex? An on-screen communication system, simple to use and inexpensive, that makes it possible to access databases through the telephone network. It may be a mere broadcast system, like Antiope, or an interactive service allowing for a reply, like Teletel. Videotex uses certain coding and display standards. At present, three major interactive videotex systems coexist in Europe: the French Teletel, the British Prestel, and the German Bildschirmtext (BTX). The French Teletel network can be accessed from abroad via an interlink that is open around the clock: Minitelnet, developed and operated by Intelmatique SA. Minitelnet is not the only way to access the 15,000 Teletel services from abroad; you can also use the international telephone network, or packet-switched communication networks, in particular Infonet. Last year, 28 international interconnections generated 150,000 hours of traffic on the Teletel network, and France exported 250,000 Minitel terminals.

#### France: Complex Circuits for Broadband Switching Developed

91AN0492 Paris *ELECTRONIQUE INTERNATIONALE* HEBDO in French 20 Jun 91 pp 1, 18

[Article by Francoise Grosvalet: "Broadband ISDN: The Circuits Are Coming"]

[Text] Telecommunications equipment suppliers are hammering out product announcements in the area of asynchronous time-division multiplexing (ATM) technology, which was upheld by the Consultative Committee on International Telephone and Telegraph (CCITT) as the cornerstone of the broadband integrated services digital networks (ISDN) slated for the year 2000. This technology should indeed make it possible to handle a variety of signals (voice, data, high-definition images) and to optimize transmission of variable or sporadic traffic loads. The future of this 28-bit packet switching technology is directly dependent upon the existence of circuits allowing ATM implementation. In fact, it is time for the components to arrive on the scene. In Europe, the French National Center for Telecommunications Research (CNET) and Alcatel have recently announced the successful development of the initial complex circuits suitable for this service. Other semiconductor manufacturers and research laboratories are also working on this topic in Europe, the United States, and Japan. In particular, Siemens should be ready to report its conclusions during the European Conference on Solid State Circuits (ESSCIRC '91), which will be held in Milan next September.

The CNET circuit was developed at the Grenoble center of France Telecom by a research team led by Roland Gerber; that of Alcatel at the group's research laboratory in Antwerp, Belgium. The CNET product is an ATM circuit which can switch 16 multiplex input signals to 16 multiplex output signals. Each multiplex signal is transmitted on four bits at a speed of 40 Mbits per second (Mbits/s), which gives the circuit a switching power of 2.5 Gbits/s. This corresponds to the transmission of 40,000 telephone links at 64 Kbits/s. The circuit, baptized CTA4, is based on a 0.7-micron complementary metal oxide semiconductor (CMOS) technology. (See box)

No marketing decision has yet been made, but the 0.7-micron CMOS technology will be transferred to Matra MHS by the end of the year. According to Gerber, the changes are very good that Matra MHS will be put in charge of manufacturing this circuit. However, as Gerber explained, nothing is urgent since "equipment incorporating these circuits will not make its appearance before 1997-98."

#### Seven Circuits for One 16x16 622-Mbits/s Switching Device

As a matter of fact, Matra MHS has already been manufacturing two other components developed by CNET which have proved to be indispensable companions of the CTA4 for producing a 16x16 622-Mbit/s switching device. The first of these two circuits is a first in, first out (FIFO) memory with a capacity of 64 words of 32, 20, and 10 bits which allows synchronization of the packets upon reception; the second is a switching matrix which performs overall control and analyzes each packet's label in order to route it into the appropriate channel. In a 16x16 ATM switching device, each multiplex signal is converted to 28 bits to reduce the rate at each input to 22 Mbits/s. Since the CTA4 uses four-bit packets, a switching device like this requires seven CTA4 circuits. As a consequence, the switching power of the system is in the range of 10 Gbits.

CNET's CTA4 circuit basic architecture consists of a 32-Kbit double-access static random access memory (SRAM) which can simultaneously read and write 16 four-bit words in fewer than 20 nanoseconds, and of peripheral control functions for routing the data in packet mode. An earlier version operated using two-bit words. The CTA4 integrates a testing device which performs, on the one hand, the functional tests on the silicon and supplies the data needed for repairing the circuit when the redundant elements provided are sufficient to correct the memory and, on the other hand, which tests the card for identifying the defective circuit or circuits in case of a breakdown.

#### 350,000 Transistors on a 24-mm<sup>2</sup> Chip

The CTA4 integrates 350,000 transistors on a 24-mm<sup>2</sup> chip and consumes about 400 mW at top speed.

Pursuant to the technology developed by Alcatel in its Antwerp laboratory, each ATM switching element is made up of two circuits: a receiving/transmitting port (RTP) and

a central memory circuit (CMC). The CMC performs the actual switching operations under the control of the RTP. In receiving mode, the RTP receives incoming data from other switching elements via a 150-MHz asynchronous parallel interface. In transmission mode, it routes the CMC-supplied packets.

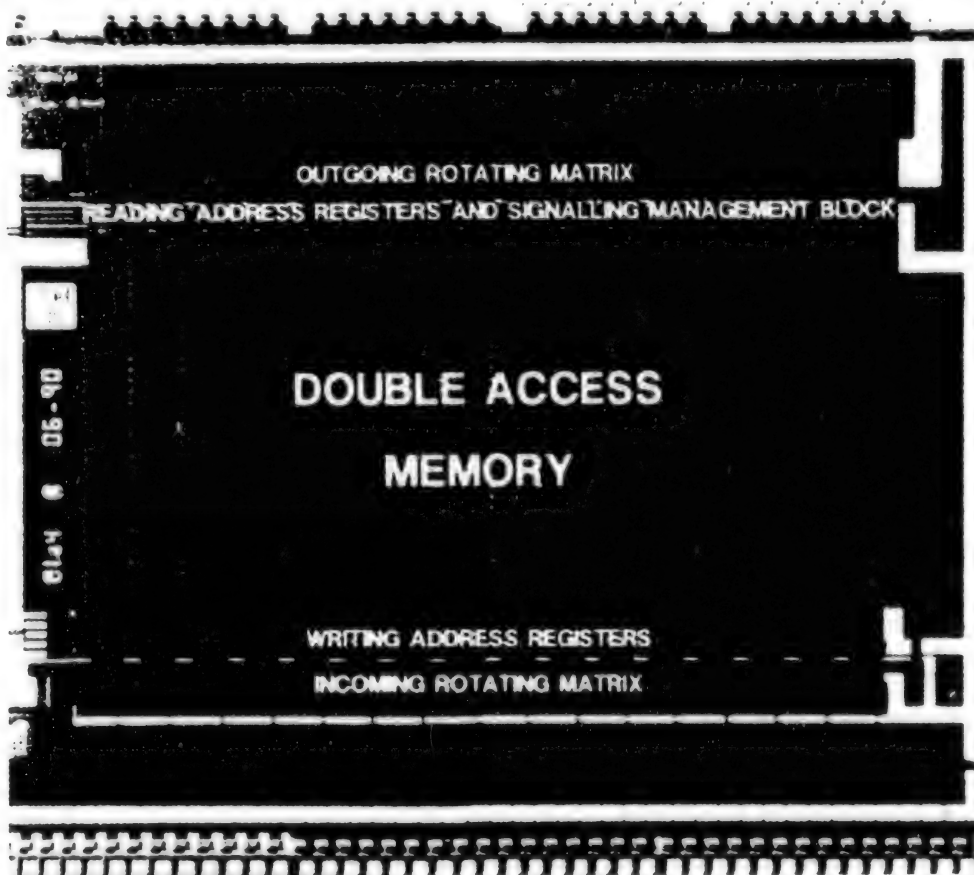
The Alcatel CMC incorporates approximately 250,000 transistors: 15,000 gates for locating 16 36-bit input registers and the 36-bit time-division multiplexing bus; a single-gate 31-Kb random-access memory (RAM). The entire circuit fits on a 100-mm<sup>2</sup> chip using 1.2-micron CMOS technology and consumes 1 watt. The second circuit, called RTP, incorporates 10,000 gates and a 1.5-Kb RAM on a 99-mm<sup>2</sup> chip using 1.5-micron bipolar CMOS (BiCMOS) technology; it consumes 2 watts. BiCMOS technology was chosen as a consequence of interface problems at 150-MHz. These two circuits operate in combination with a controller and a FiFo memory.

[Box, p 18]

#### 4.5 Million Transistors per cm<sup>2</sup>

The 0.7-micron WAI CMOS technology developed by CNET is a bimetal technology which is compatible with

previously developed circuits with 1-micron line widths. New design rules make it possible to scale down the former-generation circuits by a factor allowing a duplication of their integration density. Thus, 1 square centimeter can hold 4.5 million transistors in place of 2.1 million transistors previously. CNET's 0.7-micron CMOS technology differs nonetheless from that of the previous generation by the generalized use of the "planarization" technique, which is used more and more often in industry for production of complex circuits. The intermetallic dielectric layers erase the reliefs in such a manner that their upper surface is flat. This is achieved through the successive deposition of liquid layers of mineral glass (silicon-on-glass (SOG) technology). These deposits are made at low temperatures, as opposed to the creep process commonly used. The contact holes are completely filled with vapor-phase deposited tungsten. This rids integrated circuit designers of the constraining proximity effects. Moreover, a tungsten deposit is used as the first interconnection level which is more resistant to electromigration than aluminum. The vertical vias are filled with tungsten and an anisotropic etching process is used to eliminate the tungsten on the flat surfaces of the second dielectric layer. Subsequently, the aluminum of the second



At the periphery of the CNET asynchronous time-division multiplexing circuit is a bank with 152 contacts; the double-access SRAM is located in the center of the chip (photo by CNET).

interconnection level is deposited. In addition, the active devices produced in 0.7-micron WALCMOS technology feature other advanced technologies that simplify the design of high-capacity logical units.

In this process, high-energy mounting of the housing does not allow a temperature reduction nor the growth of fine epitaxial layers. This property also reduces the high-noise immunity which is peculiar to CMOS technology. In order to improve the performance of the devices, the transistors have a slightly doped source drain extension. The resistance of the gates, source, and drain is reduced by using autoaligning titanium silicide.

Compatibility of design rules is ensured by the manufacturers participating in the European ACCESS project (Mietec, European Silicon Structures (ES2), Matra MHS, and STC). Moreover, the majority of these technologies will be usable for next-generation 0.5-micron and 0.35-micron technologies.

#### **Alcatel To Introduce Broadband Exchange System**

91AN0480 Amsterdam *COMPUTABLE* in Dutch  
14 Jun 91 p 15

[Article by Yvonne Ton: "Alcatel Goes Along With the Need for Broadband: First Products Expected by the End of this Year"]

[Text] Paris—Alcatel has introduced the Alcatel-1000, an extensive new product line of communications systems which meet the requirements of broadband communications.

According to Mr. J. Cornu, executive vice president Business Development and Technical Operations, Alcatel's strategy consists in developing products which satisfy the needs of telecom operators and the business community for wider bandwidths and for networks with greater flexibility and reliability.

Alcatel describes its 1000 product line as a collection of building blocks needed for the development of broadband networks. The products relate to the following areas: narrow-band and broadband systems; data networks; metropolitan area networks (MANs) and switched multi-megabit data services (SMDS); network management; intelligent networks; access systems; transport systems; special transmission systems; and mobile communications systems.

Products are not yet available but will be phased in. At present the 1000 line architecture has been developed. According to Cornu, product availability depends to a large extent on the development of standards and of broadband services. The Alcatel-1000 line will gradually be adapted to broadband networks. In this way, Alcatel's existing digital exchanges, the E10 and System 12, will be integrated into the Alcatel-1000 broadband exchange, which will be the basic system for the whole product line, in only a few phases. First of all, by the end of this year, a broadband module will become available which will be

added to the two separate systems. For the period up to and including the end of next year, Alcatel has planned several products which will be based on the new Synchronous Digital Hierarchy (SDH) transmission standard for Europe and on the Synchronous Optical Networks (SONET) standard for the United States. SDH/SONET can take both narrow-band and broadband services.

#### **Germany: BICMOS Combination Array Developed**

91WS0363A Berlin *RADIO FERNSEHEN ELEKTRONIK* in German Mar-Apr 91 pp 156-159

[Article by Dr.-Ing. Gerhard Troester, laboratory director at Telefunken Electronic GmbH, Heilbronn: "1.2  $\mu$ m BICMOS Analog-Digital Arrays for High-Quality Telecommunication Systems"]

[Text] Modern communication systems, systems for pattern recognition and image processing, intelligent robots, as well as automobiles with safety and orientation systems are no longer imaginable without high-quality semiconductor components.

A combination array in BICMOS [bipolar complimentary metal oxide semiconductor] technology well suited for these purposes is presented in this article along with possible applications.

Because of the complexity and reliability of individual systems, progressive digitizing, for example in telecommunications, places great demands on the developer, the development environment, and the necessary tools. This includes a wide array of suitable design tools as well as the ability to test the efficiency of an integrated circuit rapidly and economically before final mass production.

Semiconductor arrays are one such essential aid for testing and optimizing key functions before large-scale production. For this purpose, Telefunken Electronic GmbH (TEG) in Heilbronn, part of the AEG group, has developed a combination array in BICMOS technology which will help AEG position itself in the mobile telecommunications market. With this array, AEG can quickly implement circuit changes, thus meeting an important criterion for all companies wanting to keep up in the developing European Market: the ability to react quickly and with reasonable costs to new market demands.

#### **On the Chip a Sea of Gates and Components**

In the face of increasing complexity and miniaturization, the development of intelligent interfaces between high frequency analog signals and digital signal processing is becoming more and more important. To do this, TEG has developed a combined array in BICMOS technology, consisting of an analog bipolar array and a BICMOS array.

The combination array is composed of two large areas, an HF [high frequency] array and a "sea of gates" (SOG) array (Figure 1). In both areas the core cells are arranged in a matrix structure. Each contains a large number of components which are isolated from each other.



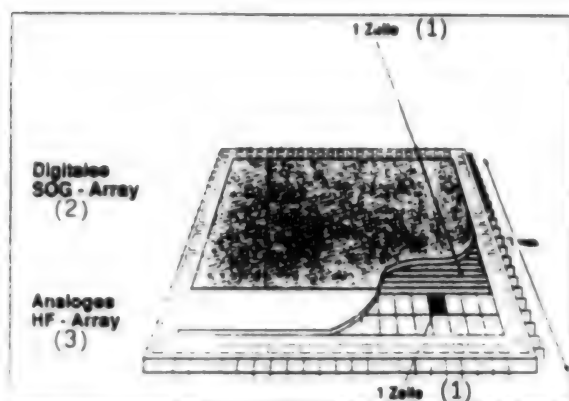


Figure 1. Structure of the combination array.

Key: 1. One cell—2. Digital SOG array—3. Analog HF array

In the HF array, 638 npn and 80 pnp transistors, 1928 resistors, and 62 capacitors are housed on about 10 mm<sup>2</sup>. At 35 mm<sup>2</sup>, the SOG part is about four times as large. It contains 126375 MOS [metal-oxide semiconductor] components as well as 3625 npn transistors. Thus, over 132,000 components are brought together on an area smaller than a thumbnail.

The application-specific conversion occurs in four successive mask steps in which the desired circuit structure is transferred to the motherboard using two metallization layers. This process, the superimposing of prefabricated structures, reduces the production time to only a few weeks. However, the large amount of area required and the associated costs limit the field of applications of array solutions to quantities of a few thousand.

#### HF Array

The core region of the HF array consists of 34 basic cells arranged in two rows. The internal structure of these cells is optimized for the construction of fast analog and ECL [emitter coupled logic] circuits. The strictly symmetrical arrangement of the variously dimensioned npn transistors simplifies the wiring of symmetrical circuit configurations such as differential amplifiers, mixers, and ECL gates. Several blocks with resistors border the internal transistor region. The different resistance values are adjusted to the transistor operating points. Special emphasis has been put on the construction of a vertical pnp transistor. Its excellent characteristics predestine it for broadband amplifiers and precise reference sources. The danger of crosstalk and cross coupling between individual components and between cells is avoided through the use of low-ohm channels for contacting the semiconductor substrate. The performance potential of this array can be evaluated with the aid of tested cells: The cell library contains preamplifiers and mixers for frequencies up to 950 MHz, adjustable amplifiers up to 100 MHz, comparators, and ECL gates with delay times of about 500 ps.

#### SOG Array

"Sea of gates" arrays achieve a higher packing density in comparison to classical gate arrays, since no special channels are reserved for wiring. However, double-layer metallization is required in order to have enough space for wiring the components. The basic cell of this SOG array forms a flexible base structure for implementation of macrocell-oriented systems. All known CMOS [complementary metal-oxide semiconductor] circuit technologies, as for example static and dynamic logic, can be mapped on this structure. The SOG array is also suitable for the integration of regular arrangements such as RAM and ROM blocks.

A problem in complex digital arrays, namely the availability of sufficient driver power, can be solved elegantly in BICMOS technology with bipolar transistors. BICMOS drivers are fitted into these array cells in such a way that the surrounding CMOS logic is not disturbed. There are more than 3500 possibilities, distributed over the array, for connecting BICMOS drivers to highly loaded cell outputs, even after cell placement. Measurements of various basic cells for signal processing such as registers, adders, counters, and ROM, confirm that clock speeds of up to 50 MHz are manageable on this array.

#### 1.2 $\mu$ m BICMOS Process Technology

This requires a manufacturing process which guarantees MOS and bipolar elements of equally high quality.

Within the framework of the ESPRIT [European Strategic Program for Research and Development in Information Technologies] project supported by the European Community, TEG developed a BICMOS process which is optimized for high-quality analog-digital applications. Such a process orientation is essential for the monolithic integration of complete functions and systems. A characteristic of the TEG BICMOS process on the bipolar side is an npn transistor transit frequency of around 7 GHz at early voltages of more than 50 volts (Table).

Table: Characteristic data of 1.2  $\mu$ m BICMOS Technology

Analog		
	NPN	vPNP
Transit Frequency $f_T$	7 GHz	2.5 GHz
Early Voltage $V_A$	> 50 V	50 V
Permissible Supply Voltage	12 V	12 V
Current Amplification	120	80
Digital		
	CMOS	
Channel Length $L_{min}$	1.2 $\mu$ m	
Gate Oxide Thickness	22 nm	
Permissible Supply Voltage	5 V	
Metal grid	3/4 $\mu$ m	

The vertical pnp transistor with its transit frequency of 2.5 GHz and early voltage of about 50 volts emphasizes the analog capability of this BICMOS technology. The TEG BICMOS process was developed based on a perfected 1.2  $\mu\text{m}$  CMOS process. The CMOS packing density, characterized by 1.2  $\mu\text{m}$  channel lengths and grid widths for the double-layer aluminum wiring of 3 or 4  $\mu\text{m}$ , is thus adopted in the BICMOS process with no adverse effect on the properties of the analog or digital components.

### CAD Design Environment

The inherent possibilities of both BICMOS technology and analog-digital combination arrays can only be utilized with an efficient computer-aided design [CAD] environment.

Two array-specific design stations have been developed in collaboration with the Development Center for Integrated Circuits (Entwicklungszentrum fuer Integrierte Schaltungen, EZIS) of AEG in Ulm. The design station for the SOG array is based on the well-known GDT software from MentorGraphics. In addition to the GDT package for layout generation and multilevel simulation, special generators and routines are implemented which make the technology data, array structure, and the cell library known to the system. Thus this CAD station supports all design and verification steps at the technology level up to the complete customization of the array.

The synthesis of high frequency circuits requires special aids such as precise and rapid extraction of parasitic components or active placement and wiring ability. AEG's PARIS design system fulfills these requirements in that it links the physical and electrical design levels with each other via a common database.

### "Intelligent Interfaces"

Because of its configuration and technical data, the new combination array is especially well suited for prototype construction of intelligent interfaces between analog signal levels and digital signal processing.

The analog side allows frequencies up to the gigahertz region. The sensitivity of the low-noise input transistors enables direct coupling to sensors such as photodiodes. Furthermore, amply dimensioned output transistors make sufficient driver power available for controlling positioning elements and signal sources such as laser diodes without additional external power steps.

In the implementation of interfaces, various tasks fall to the digital SOG array. The complexity of these arrays makes it possible to install local computing power in the array in order to handle signal preparation and processing in the analog-digital interface. The usual signal levels are supported, i.e., CMOS,  $\text{TTL}$  [transistor transistor logic], and ECL. This makes it possible to communicate with any external components, such as memory units and processors.

The flexibility of the combination array in serving different signal levels opens a wide range of applications, including mobile telecommunications systems, broadband communications, digital radio, video, HDTV [high definition television], IDTV [improved-definition television], robotics, automobile safety and orientation systems, and cordless telephones. It may be surprising that, despite ongoing digitizing, there is continued need for analog components even in the area of communications. In an analog environment, the transmission of information is based on analog signals. The performance potential of digital technology can only be tapped when the transformation between analog and digital signal levels occurs without serious loss of information.

### Range of Applications

This key function of signal conversion, which is the aim of the TEG combination array, is required in mobile telecommunications as well as in digital radio and in the video and TV sectors. Image processing and pattern recognition are requirements for intelligent robots in automation technology. In the near future, automobiles, too, will be equipped with additional safety and orientation systems which will pick up analog signals from the environment and then process them digitally.

### Mobile Telecommunications

In the mobile station for the future Pan-European ECR-900-D [European Cellular Radio] network, various analog-digital interfaces must be implemented. Especially critical is the transition between the analog 950 MHz user frequency and the digital 270 kHz signals, both on the receiving and sending ends. Standard solutions cannot fulfil this function; what is needed is high quality analog-digital conversion with the smallest possible power consumption. For hand-held devices, power consumption determines the competitiveness of the entire product.

The mobile telecommunications area of AEG has developed and introduced new solutions for this task which are aimed at reducing power. Designs cannot be sufficiently verified with simulations alone or by using classical discrete breadboard assemblies. Only construction in silicon can provide information on the actual possibilities and limitations. This silicon solution must, however, allow short-term interventions and changes, which are imperative for testing and optimization. The combination array described here is available for this purpose. The receiving end A-D converter and demodulator on the analog-digital array has been implemented in a collaborative effort between AEG and Telefunken electronic. In designing this new A-D converter, AEG took advantage of the narrow-band properties of mobile telecommunications in order to minimize circuit complexity and, consequently, power consumption.

The converter consists of three blocks. The input side interpolative  $\Sigma\Delta$  modulator samples the analog intermediate frequency signal and converts it into a rapid 1-bit

data stream. The response time of the complete feedback loop thus determines the quality of conversion. Only fast bipolar circuits make a circuit delay of less than 8 ns possible. The ratio of 1 to 4 between the analog intermediate frequency and the sampling frequency permits a simple IQ demodulation without costly components such as multipliers. The subsequent decimation filters have the task of filtering high-frequency noise from the information signal and reducing the band width to 270 kHz. Further processing of the IQ signals can then occur using standard processors. Transferring this design to the combination array with circuit technology requires about 33,000 MOS and 750 bipolar transistors. HF and SOG arrays are not completely occupied, so that additional functions can be accommodated.

#### Performance Test Results

Initial test results are available. They confirm the performance potential of this converter design not only with regard to mobile telecommunications applications, but for other narrow-band FM systems as well. The analog-digital combination array described here, the underlying BICMOS technology, and the CAD tools employed have passed their performance tests. They are now available for use industry-wide.

#### Italy: Status of Broadband ISDN Project Presented

91MI0407 Turin MEDIA DUEMILA in Italian Jun 91 pp 46-49

[Article by Giorgio Agagliati: "The Italian Path to Broadband Networks"; first paragraph is MEDIA DUEMILA introduction]

[Text] The CNR's [National Research Council] Telecommunications Project is now in its third year of implementation. The goals, the financial commitment (78.6 billion lire), and the five subprojects.

It is well known that the telecommunications sector is undergoing an evolutionary process which, though consisting of two stages, should be viewed as a continuum. Current research and standardization activities focus on the prospective evolution of narrowband integrated services digital networks (N-ISDN) in the attempt to meet the new demands of business and private users. The ultimate goal of this process is the development of the broadband ISDN (B-ISDN), based on massive use of optical fibers both for long distance and for local network connections, such as MAN (metropolitan area network).

The transition from N-ISDN to B-ISDN and the definition of the overall architecture of the latter will take at least a decade and will presumably entail a number of intermediate steps, in which the "traditional" techniques are expected to survive for some time side by side with innovative solutions, notably the "asynchronous transfer mode" (ATM), the result of roughly a decade of research into new information transfer modes, and the synchronous

digital hierarchy (SDH), for the transfer and exchange of information in optical fiber systems.

#### The TLC Project

The "Italian path" to broadband ISDN relies on participation in the EEC's research programs, such as RACE [Research and Development in Advanced Communications Technologies in Europe] on the one hand, and on the substantial investment of human and financial resources made available by the CNR's Telecommunications Project, on the other. The twice yearly meeting of the CNR's telecommunications or information theory group, which has recently taken place in the CSELT [Telecommunications Study Center] in Turin provided the opportunity for a status report on the essentials of the TLC project at the end of its second year.

On presenting the project, Professor Aldo Roveri, the man in charge, gave a brief outline of the project's main goals:

- First, "enabling domestic manufacturing and services industries to gain access to the new technologies required for the development of broadband communications so as to put them in a position to meet international competition in this sector while giving consideration to the country's development trends and to European-wide strategic options";
- Second, "combining the efforts of researchers with differing cultural and academic backgrounds into a far-reaching program";
- Finally, "encouraging suitable training for highly specialized technical staff, in a highly innovative setting."

The project, which is expected to take five years, is divided into five subprojects: structure of the broadband communication network, broadband communications technologies, terminal technologies, broadband access and interconnection techniques, experimental prototypes. Each subproject is, in turn, divided into different research areas. Besides being responsible for its coordination, the CNR is directly involved in the project through its research operations. In addition universities and polytechnic institutes as well as public and private industrial, service, and research agencies from Italy's telecommunications sector are heavily involved in the project. Tables 1 through 5 show the targets and lines of research established for the five subprojects and list the companies and agencies involved in the second year of work for each of the subprojects.

The financial commitment is heavy: 78.6 billion lire were allocated by the CNR for the five-year period, 42 billion of it for the 1989-1991 period alone. Of the latter, 10 percent were allocated to the activities carried out directly by the CNR, 22 percent to universities, 68 percent to the telecommunications, industrial, and service sectors. The investment in human resources is just as impressive: the commitment for the first year was close to 190 man-years, it grew to 240 man-years in the second year, and is expected to soar to no less than 330 man-years in the third, which has just begun. 30 percent of these highly trained staff were supplied by research centers (universities as well as public and private research institutes) and the remaining 70 percent by industrial organizations.

### The Subprojects

1. *Structure of the Broadband Communication Network.* This subproject centers on the design of a reference model for the transfer of information from point of acquisition right down to the user's terminal. Through its three research areas (network systems engineering, functional characteristics of the equipment, satellite systems for

HDTV [high-definition television] services), the subproject aims at developing network architectures, access interfaces, networks and user terminals, and at defining the role of mobile radio and satellite systems for HDTV in the wider framework of broadband communications. From 1989 to 1991 this subproject was allocated 12 percent of all financial resources, while the relevant activities involved 11 percent of the entire stock of human resources.

**Table 1. Subproject 1: Lines of research and list of participating agencies**

Network Systems Engineering	Functional Characteristics of Equipment	Satellite Systems for HDTV Services
Participants: Univ. of Catania, CSATA [Center for the Study and Application of Advanced Technologies], CSELT, Alcatel-Face Standard, Bordoni Foundation, Marconi, SIP [Italian Telephone Company], Telettra	Participants: CSELT, Alcatel-Face Standard, Bordoni, Marconi, SIP, Telettra	Participants: Tunn Polytechnical University, CSELT, RAI [Italian Radio Television], Alenia Spazio, SIP, Telespazio

Note: ISPT [Institute for the Study of Telecommunications] experts also contributed to the project

2. *Broadband Communications Technologies.* The subproject hinges on the experimental study of technologies for optically- and electrically-operated components which are known to be essential for the development of broadband networks. In effect, the prospective development of B-ISDN is based on the introduction of optical fibers into the user area as well: optical exchange

systems and the optimization of the fiber's transmission potential are, therefore, key factors in the evolution of communications. Experimental work with new techniques and components is also targeted at curbing the cost of opto-electronic systems. Between 1989 and 1991 this subproject was allocated 26 percent of the financial resources and 27 percent of the overall man-years.

**Table 2. Subproject 2: Lines of research and list of participating agencies**

Current optical systems	Optical exchange	Low cost optoelectronic components
a) point-to-point and multipoint systems	a) nonlinear optical materials and characterization of same	
Participants: CNR-CSMDR, Parma Univ., CSELT, Alcatel-Face Standard, Bordoni Foundation, Telettra	Participants: CNR-CEQSE, CNR-ICIM, Milan Polytechnic, Tunn Polytechnic, Pavia Univ., Pisa Univ., CSELT	Participants: Pavia Univ., Italtel
b) Components	b) Devices	
Participants: CNR-CESPA, CNR-IESS, CNR-IMGC, Bari Univ., CSELT, Alenia	Participants: Milan Polytechnic, Padua Univ., Palermo Univ., CSELT, Bordoni Foundation	

3. *Terminal-Related Technologies.* Assessment of hard- and software technologies and techniques for high tech terminals and experimental development of interpersonal and telematic terminals, encoders, and

TV terminals. This subproject also covers studies in HDTV. Allocations for 1989-91 amounted to 23 percent of the total assets, in terms both of financial and of human resources.



**Table 3. Subproject 3: Lines of research and list of participating agencies**

Interpersonal terminal	Telematic terminal
Participants: CNR-CSMDR, Genoa Univ, Naples Univ, Pavia Univ, Milan Polytechnic, CSATA, CSELT, Iselqui, Italtel, SGS Thomson, SSGRR	Participants: Roma 1 Univ, Crai, Alcatel-Face Standard, Sistel
TV Video encoders and relevant terminal	HDTV studies
Participants: Bari Univ, Padua Univ, Selecio, Telettra	Participants: CNR-CSTV, Florence Univ, Padua Univ, Bordoni Foundation, RAI

**4. Broadband Access and Interconnection Techniques.** This subproject is concerned with the study and the experimental development of network equipment for multimedia integrated communications (voice, data, images), based on ATM technology. Research activities are focused on user access techniques, broadband switching techniques, network related problem areas, and the feasibility study of an ATM system via satellite. Between 1989 and 1991 this subproject was allocated 22 percent of the funds and 20 percent of the available human resources.

**Table 4. Subproject 4: Lines of research and list of participating agencies**

Broadband switching techniques	User-point access techniques
Participants: Roma 1 Univ, Roma 2 Univ, Italtel, SSGRR	Participants: Bari Univ, CSATA, CSELT, Alcatel-Face Standard, Sesima, Telettra
Network-related problem areas	Feasibility study of an ATM system via satellite
Participants: Milan Polytechnic, Pavia Univ, Bordoni Foundation, Italtel	Participants: Florence Univ.

**5. Experimental Prototypes.** This subproject marks the establishment of what might be considered a real broadband "laboratory." It is here that the solutions afforded by the other subprojects are brought together, eventually to be combined in the development of a B-ISDN prototype. The prototype network will be small in size, its cores being located in different geographical areas, and will be used to check on the operational effectiveness of the technologies, components, methodologies, and new communication services as well as on their integration in a single broadband network. Another experiment will center on the adoption of a satellite network for interconnecting different LAN's (local area networks) and MAN's. The 1989-91 allocations for this subproject accounted for 17 percent of the total assets in terms both of financial and of human resources.

**Table 5. Subproject 5: Lines of research and list of participating agencies**

Experimental study of communication services	Study of high-level protocols for broadband networks	Feasibility study of an optical MAN
Participants: CNR-IROE, Florence Univ, Genoa Univ, Alcatel-Siette, Italtel	Participants: CNR-CNUCE, Pavia Univ	Participants: CNR-IROE, Florence Univ, Roma 1 Univ, Alcatel-Face Standard, Bordoni Foundation
Study and development of a deflection route selection network	Study and development of a LAN-MAN interconnecting network via satellite	Feasibility study of man-wave radio links operating in urban areas
Participants: Milan Polytechnic, Turin Polytechnic, Milan Univ, CEAT-CAVI	Participants: CNR-CSTS, CNR-CNUCE, Alena Spazio, Siemens Telecom	Participants: Roma 1 Univ, Telettra

### Dutch PTT Plans Nationwide Fiber-Optic Network

91AN0470 Amsterdam COMPUTABLE in Dutch  
7 Jun 91 p 5

[Article by Yvonne Ton: "PTT To Begin Installation of New Fiber-Optic Network; Completely Detached From Current Infrastructure"]

[Text] Groningen—PTT Telecom is going to install a nationwide fiber-optic network especially designed for advanced data transmission and tailored to new services. Investments will amount to several hundred million guilders. This announcement was made by Eng. W. Dik, chairman of the board of directors, during the presentation of the annual results of the Royal PTT Netherlands and of its subsidiaries, PTT Telecom and PTT Post.

The network, which is entirely detached from the existing infrastructure, is based on fast packet switching and frame relay techniques. A number of services will become available early next year; the PTT expects the actual network to be operational by the end of 1993. According to PTT-Telecom Director B. Verwaayen, a novel, advanced data network fits within the strategy to strengthen the company's international market position. Verwaayen emphasized that the new network will provide services which do not fall within the scope of PTT Telecom's telecommunications concession. The installation of the network may be carried out in association with other companies.

W. Dik expressed his satisfaction with last year's results. Royal PTT Netherlands made a net profit of 1.566 billion guilders, which is an increase of 7.3 percent. Net revenues increased by 4.7 percent to well over 13.5 billion guilders. With net revenues of 9.1 billion guilders and a net profit of 1.293 billion guilders, PTT Telecom made the largest contribution to the results of the PTT concern. For 1991, Dik expects "the profit growth rate to decline." He says his prospects are based on the constantly tightening profit margins due to the increased internationalization of the market, which will certainly have an impact on PTT Telecom.

The removal of some of its telecommunications concessions and the increasing liberalization of the EC market have caused PTT Telecom to face more and more international competitors. In this respect, the discussion as to whether the PTT should be split up into a concessionary and a nonconcessionary division is no longer relevant, according to Dik. Just like Verwaayen did on repeated occasions, Dik made a firm stand against a possible split-up. "Actual competition is taking place in the international market. It is beyond doubt that PTT Telecom would be impaired by a split-up. It would not make any difference to local competitors, but international competitors would be delighted."

In any event, PTT Telecom itself is expanding its foreign operations. Offices were opened in London, Brussels, and New York. Later this year, offices will be opened in Paris and Tokyo, and possibly in Germany and Italy, as well. Last year, PTT Telecom entered into several international partnerships. For instance, it took a participation in Transponet (electronic messaging for road transport) and in Comco (smart cards and smart modems). In Czechoslovakia, PTT Telecom established two joint ventures.

During the presentation of the annual results, Dik also announced that an experiment is soon to be launched to speed up—i.e., within 48 hours—the installation of new telephone connections. The PTT is also upgrading its telephone exchanges by integrating detailed telephone billing capacities. In order to make sure that telephone exchanges can handle both switching and administrative tasks, PTT Telecom concluded a contract with Tandem Computers for the delivery of Cyclone and CLX 800 computer systems. GTE Data Services, a subsidiary of the U.S. telecommunications company GTE, will supply the

software. The aim is to hook up 85 percent of subscribers to a computer-controlled telephone exchange capable of producing detailed invoices by 1994. By now, there are more than 7 million telephone connections and the 100,000th car telephone connection is scheduled for next week.

### Netherlands To Promote Advanced Data Communications

91AN0452 Amsterdam COMPUTABLE in Dutch  
31 May 91 pp 1, 2

[Article by Yvonne Ton: "Five Million Guilders for Data Communications Project"]

[Excerpt] Amsterdam—"Pilot Data Communications Projects," abbreviated TGP, is the name of the most recent subsidy scheme set up by the Ministry of Economic Affairs in pursuance of its data communications policy. Five million guilders have been made available for this incentive program. This is considerably less than the amounts allotted to earlier data communications projects.

Out of the 5-million guilder subsidy, 3 million guilders will go to these so-called pilot data communications projects. An external committee will advise the Ministry on the project proposals submitted; they will be evaluated in the fall.

The chief aim of the TGP subsidy scheme is the creation of a large-scale data communications infrastructure. The subsidized TGP projects should result in the production of substructures. With this approach, the Ministry seeks to break the vicious circle which arises because the success of data communications depends on the number of services offered, while it is only interesting to invest in telecommunication services when there are sufficient users. The Ministry of Economic Affairs has selected three areas of application for the TGP projects: chip cards and electronic labels; multimedia technology; and data security. The complete list with conditions which projects should meet will be sent to some 4,000 companies and contains an extensive appendix with examples of possible projects. The TGP scheme is aimed at implementation aspects rather than technology. "The projects should be submitted and paid for in the main by the eventual user of the new application. The technologies involved should be ready to be put on the market," according to M. Minderhout, president of the External Advisory Committee and member of the board of directors of the NMB Postbank Group. In order to qualify for subsidies, pilot projects should be submitted by users and implemented by at least three companies or institutes. Project duration may not exceed one year and subsidies will be limited to 50 percent of project costs, with a ceiling of 350,000 guilders.

Compared to earlier incentive programs for data communications, such as the Demonstration Program for Electronic Data Interchange (VEDI)—for which 15 million guilders were available—and the videotex program for small- and medium-sized companies (6.8 million), the funds allotted to the TGP scheme are much lower. Minderhout admitted that, but said that he expected the new scheme to have much impact. "The total amount

obligated, i.e., 3 million guilders, may not seem extremely high. However, we think that several rather small-scale projects with short-term results, so-called 'quick strikes,' can cause more acceleration than one megaproject." J. van Scheijen from the Ministry of Economic Affairs thinks it is "premature" to discuss possible further subsidy rounds of the TGP scheme.

Apart from the 3 million for the TGP projects, Economic Affairs has allotted 1.5 million guilders to related research. It is under consideration to have the research done by the Telecommunications Research Center, which is currently being set up at the University of Twente. The remaining 500,000 guilders will be spent on support. [passage omitted]

## COMPUTERS

### Hungarian Virtual Machine Environment Systems Described

91WS0373A Budapest *COMPUTERWORLD*/  
SZAMITASTECHNIKA in Hungarian 11 Apr 91 p 3

[Article by Zoltan Mikolas: "VME: Which Track?"]

[Text] "A number of factors hold back the domestic spread of VME although this system is expanding throughout the world. The entire country is struggling with an investment crisis, privatization is breaking up the firms into small pieces," said Lajos Ivanyos, chief engineer of the MMG-AM [Mechanical Measuring Instruments Factory-Automatic Works], in his opening speech at the VME forum held recently. He mentioned the MAV [Hungarian State Railways] as an example. It had planned to put VME electronic systems into operation this year but due to lack of money it had to abandon the investment. Luckily, for the time being, energetics is not in such a tight situation. Installation of VME has started at the power supply enterprises, such electronics figure in the plans for reconstruction of the thermal power plants too, and the Comproject office is modernizing one of the zones of the data collection system of the Paks nuclear power plant with VME.

What is the situation with domestic development and manufacture? The VME project announced within the framework of OMFB [National Technical Development Committee] target program G1 ended at the end of last year. The BME [Budapest Technical University] and the SZTAKI [Computer Technology and Automation Research Institute] participated in this in addition to the MMG. In the course of it they developed several modules: autonomous regulator, analog data collection, and PLC cards (they were thinking primarily of power plant applications for regulating systems); an interface module for an STE bus and a PROFIBUS; and, finally, various Intel oriented cards (processor module, bus arbiter/memory expander, serial/parallel I/O cards). "At the end of last year we still expected to get significant domestic and Soviet orders for these products," said Lajos Ivanyos. "Well, we are all well acquainted with the difficulties of Soviet export now. And in Hungary as a result of the combined effect of import liberalization and COCOM relaxation anybody who still has money for VME appears to be choosing a Western system." The situation is well characterized by the balance for last year: the MMG team could sign a contract for a single configuration, to a value of 1.8 million forints, while they spent more than 50 million on development within the framework of the OMFB project.

"In any case a lot of intellectual capital has been accumulated," the chief engineer said bitterly. "The question is," he continued, "whether it is worth it for us to manufacture VME hardware, and if so what? The Westerners say that the Hungarians do not adhere to the time

limits, that they produce expensively and in bad quality." So, according to Mr. Ivanyos: "What is important for us now is application, for we can choose among an awful lot of software."

The correctness of this conception was proven eloquently by the statements of those firms which came to the program as domestic vendors of Western VME products. Last year Dataware Ltd. (which also exhibited Xilinx programmable VLSI gate arrays which can be used outstandingly in VME developments) sold Motorola and Force VME products to a value of 20 million forints. Omikron, the distributor for Heurikon, also judged the business successful. We learned at the forum that since 1 January the LIAS has also been selling the VME products of PEP Modular Systems—after Unirobot. But the LIAS—unlike Unirobot—has a VAR (value added resale) contract with the PEP.

The advantage of import over domestic manufacture was also proven by those who did not come (could not come) to the program. Mr. Ivanyos said that a Western enterprise had purchased Csepel Electronics and had abolished the VME profile of the firm. And Vilati—although invited—did not represent itself.

### Oracle Software Products Adapted for East Europe

91WS0373B Budapest *COMPUTERWORLD*/  
SZAMITASTECHNIKA in Hungarian 11 Apr 91 p 3

[Article by Zsuzsa Szekeres: "Oracle Club: Users Will No Longer Get the Beta Version"]

[Text] There continues to be great interest in Oracle. The profits of IQSoft, its representative in Hungary, prove this (see issue 12, 1991, of our journal) but it is also shown by the fact that there is always a full house at the meetings of the Oracle Club in the Bathory Street conference room of the NJSZT [Janos Neumann Computer Sciences Society].

In March the club had as a guest Istvan Keller, chief of the purchase support division of Oracle Central Europe. Until the recent past the weak point of organization was the division dealing with sales in Central Europe, which is not to be wondered at if we recall that only one person at the Oracle office in Austria dealt with this theme. Now the situation has changed radically: eight experts in three divisions will take care of business in the future and as a result they are promising swifter delivery with fewer hitches. In the Oracle organization Czechoslovakia, Poland and Hungary belong to Central Europe, Bulgaria, Romania, and the Soviet Union are listed as Eastern Europe.

According to data for the period from June of last year to the end of February they did nearly 3 million dollars of business in central and eastern Europe. Of the Central European business 55 percent was done in Hungary, 30 percent in Czechoslovakia and 15 percent in Poland. Concerning our neighbors, we learned that the Polish



finance ministry is building a national information network through the Bull firm, and another similar system is being prepared on commission from the Czech National Bank and a police organ. Distributors sell Oracle products in Czechoslovakia and in our country while a firm registered in Poland works in the third Central European country.

### The Literature Is Expanding

Those affected will certainly read with reassurance that sale of the beta (that is, laboratory) versions, which cause much vexation, will be changed or abolished in the future. The decision is justified by the fact that these versions can be called a product only if the experiments have been completed. Since in this state errors may still appear in the software it is improper, indeed strictly forbidden, to install a beta version in a live environment.

Oracle Europe Center is also planning to organize visits to foreign reference sites for those interested, through IQSoft.

Discussions have begun with Oracle to set up a Hungarian training center. According to the plans some of the profits will be turned to expanding the Hungarian language Oracle literature.

Independent of this, according to Julia Sipka, commercial deputy director of IQSoft, they will translate the most important books within a foreseeable time. It is good news that the long awaited and promised Oracle textbook, developed by IQSoft experts, is at the press and will appear momentarily.

The Oracle users conference due to be held annually was to have been held in France in April. It appears that this will be postponed due to the Gulf War.

An "amnesty decree" will be prepared soon. At present the firms which sell the software officially are IQSoft, as distributor, Areco Ltd., IFSZ (Debrecen), Interflex Ltd., the KFKI [Central Physics Research Institute] Company System House, the Megamicro Small Cooperative, and the Softinvest Company as well as Sysland, with a Unisys interest, and Videoton, with a Bull interest, for the hardware offered by them. It is expected that Oracle will act more forcefully against illegal vendors.

### National Module

Miklos Pap (KFKI) gave a talk on the present status of and technical conditions for development of national language support. The KFKI System House has undertaken preparation of a Hungarian version on commission from Oracle.

We learned that with the V6 version of Oracle the NLS (National Language Support) is not a separate module, every buyer gets it with the software. This offers complete, comprehensive support for preparation of national

versions. With its aid one can change the error messages, helps, data descriptions, designation of monetary units, etc. The code for national characters, code supporting local conventions, sorting sequence and codes belonging to national alphabets can be set independent of one another. The latter also depends on the hardware devices. The Hungarian version will support the Hungarian standard (MSZ 7795/5-84), DEC Multinational and the CWI code. Naturally one can also use several character sets at once—with the Conversion function. In addition the software can be made to fit any special enterprise standard. Such a requirement arose, for example, at the State Insurance Office.

The speaker also called attention to limitations. One cannot sort together two character sequences which have different code and the system cannot sort double characters into their place according to the Hungarian alphabet.

They plan to complete the work by June of this year; that is, they will create a version which can do the above. The first version will work in a UNIX operating system and it will be followed continually by others as needed.

### Latest Videoton Products Presented

91WS0373C Budapest *COMPUTERWORLD/*  
*SZAMITASTECHNIKA in Hungarian 11 Apr 91 p 5*

[Article by H. B.: "Fehervar Folks in Hannover"]

[Text] Videoton was one of the first Hungarian exhibitors at the CeBIT expositions. They have appeared every year, this year also in their accustomed place. And it appears that the Fehervar firm, fighting to survive, may have shown its most interesting offering this year. Among the high powered line printers seen in earlier years also—thanks to their special sound insulation these operate at a noise level under 55 dBA—we could see model 22060. The speed of these is 650 lines per minute in the case of a set consisting of 66 characters and is 480 lines per minute for a 98 character set. The lines can consist of 132 or 136 columns.

A new item was the electronic multiplexer system, which they began to manufacture this year. The product appears to be successful already, there was very great interest in it. With justice, for it is a truly modern communications device which directs transmission of data and speech to (postal) telephone lines. A personal computer, telefax, message recorder, telephone set or telephone line can be connected to the device. The modem automatically answers an incoming call and sends the call on to the device which is being called. The user can program the EMS [Electronic Multiplex System] according to various special applications and data protection requirements. The equipment uses little power and has automatic self testing and can also be used as a small in-house telephone exchange.

A public terminal displayed jointly with the American firm Transfer Technologies, Inc., is also connected with transmission technology. It unites in itself a credit card telephone and a telefax set. Such devices appeared recently in busy airports in the United States and in other publicly accessible points to satisfy the need for "information here and now."

Actually the device is a combination of an intelligent telephone and a telefax through which the user can exchange messages with his bank, place of work or other addressee in the strictest confidence. A printed bill concerning the exchange of messages and the sum to be paid—by credit card—is prepared immediately. With the great international traffic at airports it is understandable that even the models intended for the American market know several languages; the user himself can select whether the system messages appear in English or another language. In accordance with market trends there will be an increasing demand for such devices in Europe as well. It is not excluded that Videoton will have an important role in spreading and maintaining such equipment for the Americans will probably commission the Hungarian firm to take care of the product throughout Europe. Transfer Technologies also has electronic vending machines and automatic tellers and the Fehervar folks may be responsible for these too.

Videoton also marched out their displays, small modems and power units made for PC's. With the Far East competition these can be manufactured economically only in runs of several hundred thousand. It is still a question whether this should be done despite the fact that the power units were found to be outstanding even meeting the strict American requirements. But with the unheard of market competition and the complete lack of a Hungarian parts base the chances for economical manufacture are not too great.

Videoton also demonstrated its subassembly manufacturing capabilities, already made use of by a number of world firms—including IBM. The Fehervar folks are trying everything in the interest of exploiting their assets and avoiding lay-offs. At the center of the stand the firm showed computer technology teaching materials developed or traded by its division with a German interest. These materials included modules stored on video cassettes and computer programs. There was gigantic interest in these. And not by chance for they included such fad items as Windows 3.0.

Talking with the Fehervar folks of course they mentioned their problems, the privatization, the difficult to comprehend international contacts, their high hopes and the dashing of them. But it became clearer than day for anyone interested that many people at Videoton, working at many sites and in some cases offering the only industrial base in the region, are struggling to see that they are not forced under.

## FACTORY AUTOMATION, ROBOTICS

### Current Status of Czechoslovak Computer Networks Reviewed

91WS0369A Prague *MECHANIZACE  
AUTOMATIZACE ADMINISTRATIVY in Slovak*  
Apr 91 pp 157-161

[Article by docent Eng. Ivan Hanuliak, candidate for doctor of science (CSc.): "Current Status of Czechoslovak Computer Networks"]

[Text] One of the most pressing tasks facing our society is the issue of distributed data processing. The pages of our professional journals have already devoted considerable attention to this topic. Most of the discussions have been restricted to the classification of the individual directions in distributed data processing. Gradually, in line with worldwide developments in network computing, our experts have become aware of issues related to regional computer networks from differing viewpoints. These issues include architectures, reference models of individual components, the modelling of networks and their elements, network protocols, suggested basic parameters for these networks, in particular performance standards and how to speed up the transmission of data units across the network, standardization efforts, and the description of specific networks that have been setup worldwide.

Similarly, in line with the increasing worldwide importance of personal computers and their interconnectivity, articles have been appearing with greater frequency in our professional press concerning local computer networks (LAN—local area network). As LANs have evolved, articles have appeared informing our experts about specific LAN architectures, various transmission protocols, interconnecting LANs with each other, and with already existing regional networks. This primarily takes the form of public data networks across so-called "bridges" or "gateways." Other articles have evaluated and compared existing LAN architectures in terms of their performance, transmission efficiency, reliability, and network data protection techniques. These articles, however, were based on available foreign professional sources and selectively presented the findings and experiences gained from proposals, experimentation, operation and evaluation of networks implemented elsewhere in the world.

This approach has created in the CSFR the false impression that we have been following networking developments in a consistent fashion. This impression was not, however, reflected in an expansion of specific network applications, in other words, in the practical availability of network hardware and software resources that would allow users to install simple applications of a chosen network.

Because of these realities, and numerous suggestions from practitioners, this article intends to summarize the current status of networks worldwide, and the reflection

of these developments in the CSFR. In this way we want to provide a basic information about computer networks for a hypothetical typical network user. This is a user not deeply involved in the actual definition of the network, but for whom the chief criterion is how well the chosen network meets application needs.

### Network Classifications

Currently there are two basic groups of computer networks:

- Regional Networks (wide area networks, long haul networks). These networks enable the interconnection of territorially remote computers using available telecommunications devices. This group includes various kinds of terminal networks, in which different devices are connected through remote data transmission. Regional networks are characterized by a data transmission method called "store and forward," i.e., record and send along, a technique analogous to the technique used to send telegrams over a telegraph network.
- Local Networks (local area network—LAN). These networks are independent of communications because the elements of the network are hard wired together, most frequently using twisted pair or coaxial cables with an impedance of 50-75 ohms. In the future, fiber optic cable will be used.

Worldwide, regional networks can be categorized as follows:

- Homogeneous networks. These mainly include the highly successful company architectures DNA (digital network architecture) of Digital Equipment Corporation and SNA (synchronous network architecture) from IBM.
- Public data networks. These networks are established and maintained by communications companies and administrations.
- IDN (integrated digital network) and ISDN (integrated services digital network) networks. These are integrated digital networks or digital networks with integrated services that allow, in addition to all current transmission services (text, voice, and the like), new data transmission services (telematic services) over a single integrated digital network.

Similarly one can categorize local area networks as follows:

- LANs. Universal LANs that allow the interconnection of a wide range of equipment with different transmission speeds. The most frequently used transmission technique is "baseband," i.e., the direct transmission of digital signals without modulation, usually over coaxial cable with an impedance of 50 ohms.

- High speed LANs. Known as HSLN (High speed local networks), their purpose is to provide high transmission speeds among individual high capacity memories of connected computers (speeds of 100 to 200 megabits per second). The most frequently used transmission technique is "broadband," which involves transmission in a translated band, in which the transmitted analog signal is modulated by values of an input digital signal. This form of transmission usually employs coaxial cable with 75 ohm impedance.

The main differences between these main groups of computer networks are neither their names nor the physical location of their connected equipment, but the speed of communication, the transmission media used, transmission reliability, and the technique used to connect networked computers.

Both types of networks share the actual communication technique, namely packet switching (a packet is a part of the transmitted message that carries with it all necessary control information for its transmission from the source to the target).

### Worldwide Development of Networks

Worldwide development of networks began in the 1970s with the installation of regional networks. At this time the dominant computers were minicomputers and large, data center mainframes. Regional networks improved the utilization of the mainframes, and allowed remote users to access the mainframe power from a simple terminal.

Construction of the largest packet switching network, ARPA, began in 1968. By 1969 it was already operating experimentally with four minicomputer nodes. Other regional networks developed on this basis, along with the expanding implementation of proprietary networks set up on these foundations (DNA and SNA). Because of the costs involved in building and expanding user regional networks, work began on building public data networks. These were built and maintained by communications administrations and allowed access from a user's terminal, for a modest fee, to a data center mainframe and its extensive data bases.

The advent of the personal computer in the mid-1970s created the basic conditions for their interconnection and cooperation. A decisive factor in this teamed network cooperation among personal computers was the very flexible stance of leading telecommunications companies, which attempted to keep communications costs as low as possible. This in turn led to the rise of many manufacturers of modems for personal computers. In the beginning these were stand alone units, but soon they became available as part of integrated circuits (installed modems) with transmission speeds of 300 to 4,800 bits per second.

To support communications among personal computers new, simplified protocols were introduced, like the successful XMODEM protocol in 1978.

This approach, involving the gradual development of integrated circuit manufacturing technology, allowed the personal computer to become a universal instrument with which it was possible, through hardwired connections with other personal computers (a LAN) to participate in existing regional networks. For these purposes the personal computer was outfitted with a communications adapter for LAN communications and an installed modem for communication over phone lines. Concurrently the capability was being developed for interconnecting individual LANs using "bridge" circuits, and their interconnection to regional networks using "gateway" circuits.

LAN communications, or their interface with regional networks, is usually implemented through a dedicated specialized computer, called the "communications server." The role of this dedicated computer is the transmission of files in the LAN context (a file server), as well as the control of transmissions between both types of networks. We can include the function of a "print server" in this categorization, i.e., the use by the network of a high quality printer connected to the server. This merging of services reflects the trend in the network operating system software for modern LANS developed by NOVELL, NETIX, and BANYAN (VINES).

Currently the following types of local networks have been standardized:

Bus local network using the CSMA/CD access method—ISO 8802/3;

Bus local network using the "token bus" access method—ISO 8802/4;

Ring local network using the "token ring" access method—ISO 8802/5;

Ring local network using the "slotted ring" access method—ISO 8802/7

At the proposal stage is the FDDI standard (Fiber Distributed Data Interface) for transmission speeds of 100 megabits per second using a fiber optic transmission medium.

Based on access method, all known types of LAN networks can be grouped into one of the following three categories:

Random access networks (the most frequently used technique is CSMA/CD—Carrier Sense Multiple Access with Collision Detection);

Deterministic access networks (token bus, token ring, slotted ring, and the like);

Combined access networks (the access cycle is divided into intervals in which random and deterministic access alternate).

The most widely used type of network worldwide is "Ethernet" (several hundred thousand users), which uses the CSMA/CD access method.

### Regional Networks in the CSFR

The sophistication of data transmission services is of critical importance for the establishment of regional computer networks. Data transmission services were formally introduced by the communications sector in the CSFR in 1971. However, so far this sector's concept of data transmission has been restricted to the secondary use of the existing telecommunications network. At the beginning this meant the use mainly of the long distance Teletype network and more recently of the public phone network using both switched and permanent circuits.

A long standing factor that has delayed the expansion of data transmission services is the lack of the necessary equipment, both for users (computers and terminals) and in the communications sector itself (modems). The initial relatively promising growth in data stations was due in part to the startup of modem production by Czech and Slovak industry in 1973-1975. These modems had communications capabilities of 200 bits per second and 600/1,200 bits per second. Unfortunately, the ensuing ten years of almost no modem development has resulted in a situation where the MDS 200 and MDS 1200 modems produced in the early 1980s were not of the same quality as the computers of that period. For this reason, in 1984 an R&D and production program for modems was initiated (600/1,200 and 1,200/2,400 bit/second modems).

We have not yet overcome the resultant technological backwardness. Experience has shown that current world practices demand equipment that can provide reliable, efficient high speed transmission as well as support the current transition to digital information transmission (the digitization of the phone network with the introduction of data transmission services).

The ongoing digitalization of world telephone systems gives rise not only to data transmission services on public phone lines, but also provides the foundation for the gradual introduction of so-called telematic services (teletex, telefax, videotex, teleconferencing, etc.).

The basic problems in expanding data transmission services in the CSFR are:

A serious shortage of modems with transmission speeds of 1,200 bits per second;

The high cost both of renting permanent lines and of the actual long distance transmission of data on switched lines;

The low reliability of data transmission when using permanent lines.

The way out of this situation is to:

Make available reliable internal (board) modems for personal computers with transmission speeds from 300 to 4,800 bits per second. Tesla Liptovsky Hradok currently manufactures internal modems capable of 300-1,200 bit per second transmission;



Gradually digitize the Czech and Slovak telephone networks. The basis is the installation and extension to subscribers of a digital channel with at least 64 kilobit per second speed.

Despite the unfavorable situation in data transmission services, work on the problem of regional computer networks began in the CSFR in 1976 at the Institute for Applied Cybernetics in Bratislava. In cooperation with many other institutions in our republic, this institute implemented in 1980 an experimental data network for transmitting packets between three nodal computers. Since 1986, a modified and expanded version of the basic 1980 configuration has been providing selected subscribers with network services, in the form of remote terminal access and file transfer for a fee. The entire 9/87 issue of MAA was devoted to a more detailed chronology of the development of this network. The technical components of this network were JSEP (computing capacity) and SMEP computers, which were outfitted with communications equipment developed at the Zilina Computer Research Institute [VUVT] to handle the transmission services.

Since 1986 the hardware has been upgraded with microcomputers, and new generations of the SMEP minicomputers have been installed. The Prague Communication Research Institute is basing plans for a public data network for the CSFR on the results achieved by this first network.

The Zilina VUVT has developed a number of other pieces of communications hardware for the JSEP and SMEP computers which, in conjunction with SYRPOS network software, is making it possible to create regional networks based on the assumption that the user will be able to overcome the above mentioned basic problems with data transmission. Even if this occurs, however, these computers do not represent the main thrust of computer applications. The main thrust in this country has become high performance personal computers such as the IBM PC XT/AT/386 and their available equivalents.

#### Local Computer Networks in the CSFR

The conditions for an expansion of local computer networks in the CSFR are considerably more favorable than those for regional networks. This is because: LANs are implemented independent of the existing level of data transmission services. Only when there is an attempt to connect two territorially remote LANs does the need arise to make the connection using existing telecommunications lines;

- There are domestically produced LANs (PP NET from Zilina VUVT), as well as LANs from foreign manufacturers, which are currently being supplied by, for instance, the Slusovice United Agricultural Cooperative [JZD].

All available types of LANs are of the Ethernet bus type. The PP NET network is a token bus type. In cases of bus

types other than Ethernet, the impact is only on the way the communications adapter is installed and the type of network software involved. For this reason therefore, this article describes only the most generally required equipment for computers to be connected to a LAN, as well as the network software.

Currently throughout the world the necessary communications and technical equipment is designed based on large scale integrated circuits (VLSI circuits) which perform tasks previously belonging to the network operating system, in addition to controlling the physical serial transmission of data.

#### Communications Hardware for LAN Computers

Every computer to be connected to a LAN must be equipped with a board that enables connection to and communication with the network, a so-called "communications adapter" (LAN board). As a rule, connection of a single computer to a common communications medium (twisted pair or coaxial cable) through this communications adapter, requires a single switching box (a tap box) and a piece of connecting cable (tap cable) with ends that can be plugged into the communications adapter on one side and to the tap box on the other end. This connection is shown in Figure 1. The terminators shown on Figure 1 are actual switching boxes modified with the addition of terminal impedance so that when the electrical signal is broadcast on the common line it is not reflected at the end of the line. The LAN configuration shown in Figure 1 represents a common module, or "segment" of a LAN.

Future expandability is assured by the multi-segment architecture of the network. This is based in another piece of hardware, the so-called "repeater." This device regenerates the parameters of the transmitted electrical signals. The architectural principle of this network is shown in Figure 2.

The communications adapter is equipped with the following switches to allow the the board to be configured: 8-bit switch for setting the node address;

Position switch to select interrupt level;

Position switch to select the DMA channel;

Position switch to select the mode for the remote launch of the network software from another network node or from the "server" (in this mode the connected computer does not have to have any disk or diskette mechanism);

A change in the location of the I/O address space.

These switches are set by the manufacturer to positions that provide smooth operation in the delivered configuration. If a user needs to change the basic setting (perhaps because he has another board in the computer that has the same address as the communications adapter), he can do so easily by referring to the user manual for the specific network.

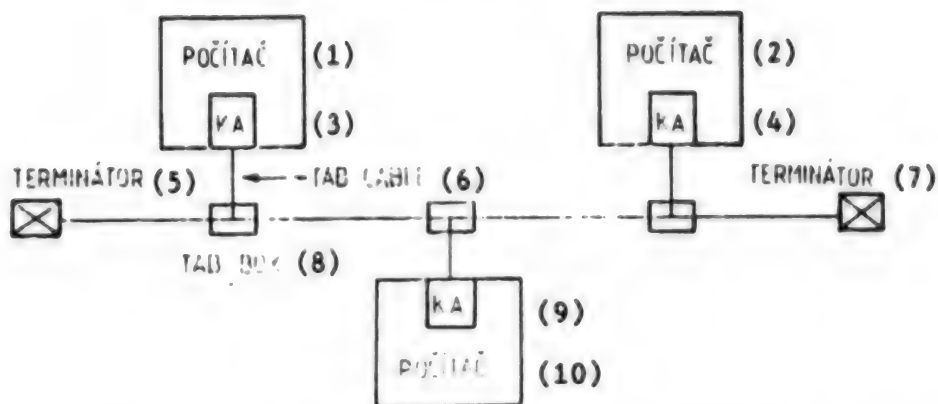


Figure 1.

Key 1. Computer—2. Computer—3. Communications adapter—4. Communications adapter—5. Terminator—6. Connection cable—7. Terminator—8. Switching box—9. Communications adapter—10. Computer

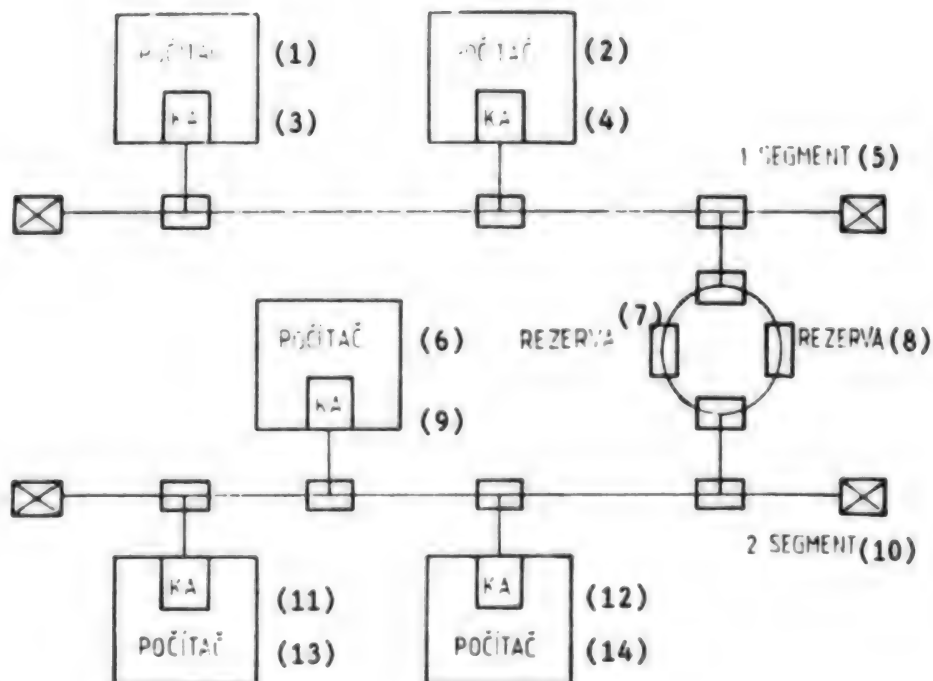


Figure 2.

Key 1. Computer—2. Computer—3. Communications adapter—4. Communications adapter—5. Segment 1—6. Computer—7. Reserve—8. Reserve—9. Communications adapter—10. Communications adapter—11. Communications adapter—12. Segment 2—13. Computer—14. Computer

### Network Software

The basic distinction is between the type of operating system used in the connected computers. There are basically two types of operating system:

Single-user (for example, MS DOS 3.3 and prior versions for the personal computer).

Multiple-user, which includes programming for communications among individual users of the computer system (examples include UNIX and OS/2). For communication among various computer systems (a network of computers) it is sufficient to add programs to existing equipment that control transmission for a common transmission medium.

Another important aspect of network software is the ability to communicate not only among individual hard-wired computer systems through serial ports (in a LAN), but also the capability to communicate across either switched or rented permanent communication lines, in real time, using a modem (for communication not only among LANs, but also to connect a LAN into a regional computer network).

Supplied network software for a specific type of network comes with the capability to select a topology for connecting the networked computers. These include usually serial connection, the star topology (one controlling, all others controlled), or a combination of star and serial topologies. This allows the user to select the specific type of connection himself using the setup or so-called configuration program. In addition to a configuration program, network software contains services to control contact with specific transmission resources (drivers) and special purpose service modules that perform individually defined network services (entities).

The structure and scope of these entities constitute the capabilities of the network from the user's perspective.

The basic LAN services are as follows:

Common use of previously identified network resources (files, peripherals, etc.);

File communication across the network, including electronic mail.

Interactive network dialog.

The issuing and execution of commands and programs on other computers in the network.

In addition to these basic network services, demands are more and more frequent for higher forms of distributed data processing, such as access to distributed data bases, to data bases with repetitive terminal access, and the like.

### Technical Properties of Available Personal Computer LANs

In this overview of available LANs we will not include developments for the now obsolete 8-bit personal computers. For example, Bratislava Tesla produces the LS 3

network and its updated version, the LS 3-PP with a PP-06 control computer. Nor will we spend any more time on the local network for SMEP computer systems that has been developed by the Zilina VUVT (a bus, Ethernet type local network with 10 megabits per second, and a token bus type bus local network with 500 megabits per second for 16- and 32-bit minicomputers with a unibus. Model PP-06 and PP 01-06 personal computers can be connected to these networks through a concentrator). Rather, I will devote my attention to currently available local networks for 16- and 32-bit IBM PC XT/AT/386 high performance personal computers and their compatibles.

#### 1. PP-Net Network

This network was developed at the Zilina VUVT. It is designed for the connection of PP-06 and PP 01-06 computers. The communications adapter specified for this network as the AKM (autonomous communications module) is on a single board that inserts into a free position in the system unit of the PP-06 and PP 01-06. The Zilina VUVT also developed a communications adapter for connecting IBM PC XT/AT/386 and their compatibles. This network is a token bus type bus network with a 500 megabit per second transmission speed. The network requires the PP-DOS 3.0 operating system. The system architecture is currently single segment and allows the theoretical connection of 100 nodes. The length of transmission lines for a single segment is a maximum of 500 meters. The required transmission medium is coaxial cable with an impedance of 50 ohms. PP-Net is available as the network operating system.

The PP-Net network provides the following services:  
Common use of peripheral equipment (hard disks, printers, etc);

Common use of disk files;

Potential to secure user files;

Electronic mail;

Capability to secure through passwords;

Capability to start programs on remote computers.

#### 2. TNS NET-900

This network is built on the standard 16-bit IBM PC XT. The control computer (star on bus typology) can be either an IBM PC XT, a 286 or 386 AT, with the satellites being computers like the TNS HC-16/1M or the TNS-XT. The access method is CSMA/CD. Individual computers are connected using coaxial cable with 50 ohm impedance. The maximum length is 500 meters. The optimal number of network users is 5-10. The transmission speed of the network is 888 kilobits per second. In computers without their own internal memory (hard disk or diskette drive), the network operating system from the control computer is invoked using

the program AUTOBOOT, which is stored in the communication adapter ROM. The Slusovice JZD Agrokombinat supplies this network.

### 3. RPTI-NET

The RPTI-NET 1000 (Trans-Net) and its upgraded version the RPTI-NET 3000 are Ethernet type networks that allow the networking of IBM PC XT/AT/386, PS/2 model 30 type computers and their compatibles. The transmission speeds are 1 megabit per second for the RPTI-NET 1000 and 10 megabits per second for the RPTI-NET 3000. The systems have a multi-segment architecture. The maximum length of the transmission line for a single segment is 300 meters and the total allowed transmission line length is 1,200 meters. The maximum number of nodes that can be connected to any segment is 32 (a node being either a computer or a repeater), and the number of connected computers can be expanded to 255. The system requires either an MS-DOS or PC-DOS operating system, version 3.1 or higher. Available network operating systems include RPTI-Net, Novell Corporation operating systems, and, with the help of a NETBIOS emulator, the network operating systems for IBM networks. In addition to the basic network devices the following network applications are available:

Electronic mail;

Disk server (a hard disk that acts as a file server);

Remote boot (launching operating systems from the server);

Screen monitor (capture and transmission of screen prints).

The Slusovice Agrokombinat JZD provides a single segment RPTI-NET 1000 system based on a communications adapter without foreign currency cooperation.

### 4. D-LINK Networks

This network is a product of the American firm D-LINK Systems, Inc. It allows the networking of IBM PC/XT/AT/386 and PS/2 computers and their compatibles. The network has a multi-segment architecture. The maximum length of the communications media for one segment is 255 meters. A maximum of 16 nodes (either a computer or a repeater) can be connected in each segment. The total length of the network communications media cannot exceed 1,000 meters. A maximum of 255 computers can be attached to the network. Transmission speed is 2.5 megabits per second. The network requires MS-DOS operating systems, versions 3.1 through 4.0. The network is program compatible with ARC-Net type networks. This allows the network to operate with not only the delivered D-LINK LAN smart operating system, but also with NetWare and other

network operating systems for SMC ARC-Net. In addition to basic network services the following applications are available:

Electronic mail;

Screen monitor (Capture and transmission of screen prints)—very advantageous for training and teleconferencing;

Remote boot (launching the network operating system from other network computers);

D-LINK Bridge, allowing D-LINK networks to connect to D-LINK 10 type networks (transmission speed of 10 megabits per second);

Common use of a modem or asynchronous communications device installed in one network computer (modem card) by all the networked computers.

The Slusovice Agrokombinat JZD provides a single segment D-LINK network (transmission speed of 2.5 megabits per second) based on a communications adapter without foreign currency cooperation.

### Conclusion

I have attempted in this article to summarize current worldwide developments in networking and to describe the actual situation in this area in the CSFR. With this in mind I focused on the basic elements that are most important for users when implementing a local computer network, namely specifying the network. I also took account of the fact that the changed conditions have opened for many users access to other suppliers and different types of LANs.

In my opinion the main emphasis in the CSFR in the near future will be on the formation of local computer networks for interconnection of the computing resources in individual institutions.

It is very important that during this first stage in the building of information systems the foundations be laid for the gradual integration of individual institutions into larger, regional systems using long distance data transmission equipment, and that the conditions be created for the mutual interconnection of all existing computer resources.

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